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THE COAL AND IRON RECORD.

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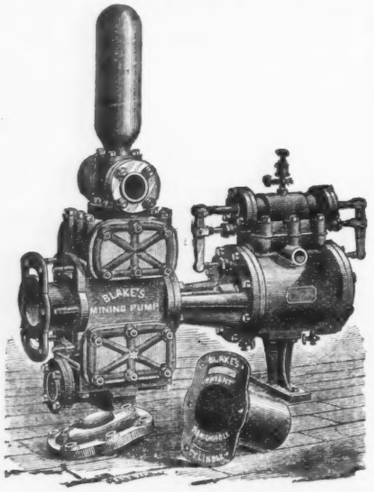

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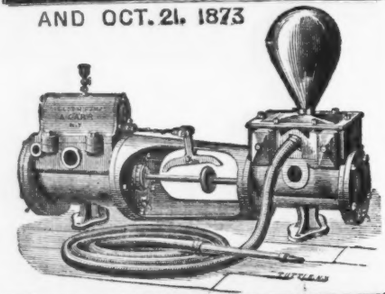

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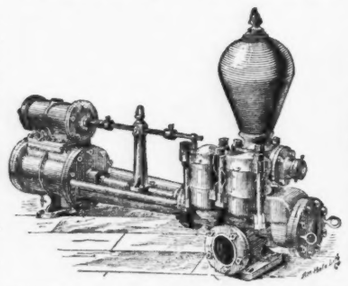

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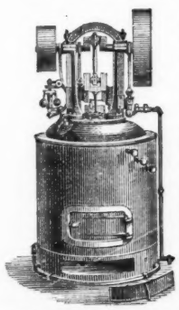

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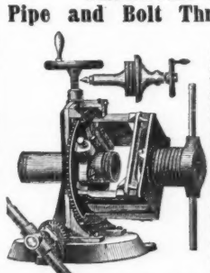

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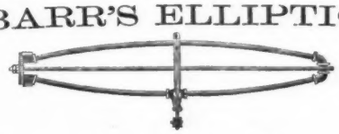

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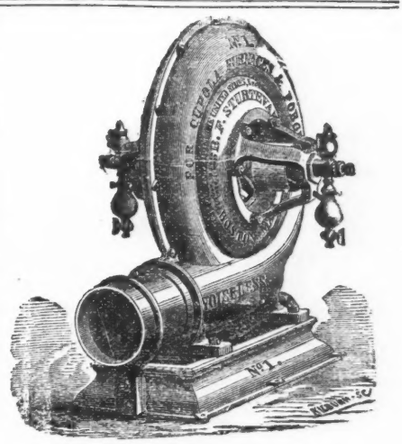

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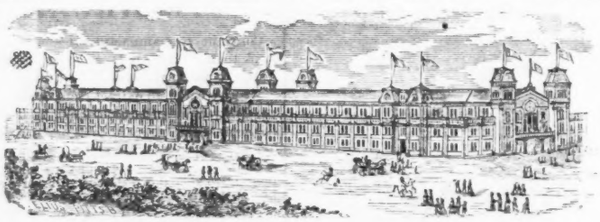

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THE ENGINEERING AND MINING JOURNAL.

RICHARD P. ROTHWELL, C. E., M. E.
ROSSITER W. RAYMOND, Ph. D. } Editors.

NOTE.—Communications relative to the editorial management should be addressed to Mr. ROTHWELL. The articles written by Mr. Raymond will be signed with a star.

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The Largest Mine Pumps in the Coal Regions.

THE Vulcan Ironworks of Wilkes-Barre, Pa., which stands among the best machine shops in this country, is now completing, for the Susquehanna Coal Co., a direct-acting "bull" pump, (sometimes called a "Cornish" pump) which, for dimensions and excellence of workmanship, is well worthy of note. This gigantic engine has a vertical steam cylinder 65 inches diameter and ten-foot stroke, which works two plungers each 24 inches diameter and ten-foot stroke; these force the water to a total height of 550 feet, each pump lifting it 275 feet. Without full specifications it would be impossible to form an idea of the amount of work on such an engine, but some appreciation may be formed from the fact that this machine will cost in the vicinity of $20,000, and was contracted for under very close competition.

Some months ago, the Dickson Manufacturing Co., of Wilkes-Barre, built for the Audenried shaft of the Lehigh and Wilkes-Barre Coal Co. a direct-acting pump, of which the steam cylinder was 70 inches diameter, ten-foot stroke, and the lower plunger 20 inches diameter, lifting 377 feet; the upper pump 22 inches diameter, ten-foot stroke, working a lift of 484 feet, making a total height of 871 feet. The Marom Shaft, Scranton, has a pump 50 inches diameter by ten-foot stroke, with a plunger 24 inches diameter. The Pyne Shaft of the D. L. & W. R. R. Co., the D. & H. Canal Co.'s Plymouth shaft, and the L. & W. Coal Co,'s No. 12 shaft, have each pumps 50 inc hes diameter, ten-foot stroke, with plungers of 22 to 24 inches diameter.

Engines of these large dimensions are now common in the coal regions, and are finished in a manner which reflects the greatest credit on the manufacturers, and shows the enormous progress that has been made in the construction of mining machinery within the past ten years.

Coke Combination in the Connelsville Region.

THE coke trade of Southwestern Pennsylvania has suffered greatly from the prostration of the iron trade Many of the ovens had to stop, prices having receded to a point below even the remarkably small cost of making coke in that favored region. Close competition and low prices have, it appears, produced the same effect there as here, for we find in the Uniontown (Pa.) *Standard* that the coke operators have had a meeting, and formed a "Combination" to regulate prices. At the meeting 2,449 ovens, or more than two-thirds of all in the Connelsville region, were represented, and the following plan was proposed and favorably received by all:

"It is proposed to organize a Board of Control, composed of manufacturers and shippers. The shippers must be manufacturers, but the manufacturer who has less than 100 ovens cannot be a shipper, unless he combines with some other producer to make up the requisite number of ovens that will enable him to become one. All orders coming through shippers will be divided *pro rata* amongst the producers, and they will receive for the selling of the same a fair commission, fixed by the Board of Control. The prices in Pittsburgh and at works will be co ntrolled, also, by this Board. They bind themselves not to sell to any one buta shipper, unless it be direct to the consumer, and then they must be governed by the prices fixed by the Board. Of course, it is to the interest of the shipper to keep the price up, for he is a producer, and it would be suicidal for him or them to cut the price. A committee was appointed to get signers, a great many of those present having already put their names to the contract. It is a pity that this Board couldn't have been thoroughly organized before parties entered into contracts to supply coke for a year at something like 2⅜ cents per bushel; for the price of coke is bound, under the present arrangement, to be firmer. Co-operation is the only chance for the coke producer, and never did a better opportunity offer for the success of the trade than the present plan."

It is evident that there is no place in this arrangement for the "middleman," and, indeed, it is probably the best and wisest arrangement that can now be made; for it brings the producer and consumer together, and thereby lessens cost. Every plan that tends to reduce the cost of supplying the raw material to the consumer works to the general advantage, and the tendency of modern industry is toward co-operation among producers, with the view of reducing cost of production. A mere trade combination to keep up prices, while it may have advantages in steadying and regulating supplies, as has been the case with the Anthracite Combination, is yet, in general, a poliey fraught with danger to the public. In the particular case of the coke manufacturers there is little chance of any injurious combination, for there will always be sufficient competition from those outside of the Combination to prevent an undue increase in price; while, on the other hand, it may enable the producers of the Connelsville region, by cutting off some unnecessary expenses, to bring back prosperity to an industry that has been unprofitable of late.

Protection in Canada.

As a rule, Canadians, like Englishmen, are ardent believers in the free trade doctrines, and if we were to take as argument the immense progress that Canada has made in the past ten years, (unblest as it has been by either a high protective tariff or that other source of universal prosperity, an irredeemable paper currency,) we might be inclined to think there were two sides to these tariff and financial questions, and that, perhaps, our neighbors are as near right as we.

During the past three years, while business in this country has been thoroughly prostrated, Canada has almost escaped the effects of our panic; this immunity could not be expected to continue long while every other country, in Europe or America, was suffering that prostration of business with which we have become so familiar. And now that "bad times" have come on our Northern cousins, they have gone to work to strike a trade balance, and begin to think that while their coal mines are standing idle for lack of orders, as they say, because we lock their coal out of our markets by a duty of seventy-five cents gold per ton, it is scarcely fair we should be allowed to send them our coal free of duty. The coal operators of Nova Scotia are therefore petitioning their government to impose a duty on coal, iron, &c., imported into Canada from this country, and the few Canadian iron masters and the larger number of owners and speculators in iron mines, are joining in the demand. Now, since we advocate the great advantages of protection to every country, we cannot well object if the Canadian Government should impose a heavy duty on the importation of our coal into that country; but at the same time we cannot close our eyes to the fact that such a course would be greatly to our disadvantage, and would much reduce our exports to our best customers. It would doubtless have for immediate effect to greatly strengthen the reciprocity party here, for should our best foreign market be closed to us, except on these terms, we might find "reciprocity" would pay.

Extra Large Lap-Welded Tubes and Enameled Water Pipes.

AT a recent visit to the works of the National Tube Works Company at McKeesport, Pa., we witnessed the operation of making lap-welded tubes of such a size and quality as to call for notice. The Company makes these seamless tubes or pipes of any size up to *fourteen inches diameter*. And as every length is tested by hydraulic pressure before leaving the works, their strength and quality is fully guaranteed. They have been found admirably adapted to carrying water for the hydraulic mines of California, Nevada, and other Western States, and for waterworks which do not require larger mains than 14 inches. The Company has just completed an order for the Virginia City and Gold Hill Water Company, of Nevada, of seven miles of 10-inch pipe, the most extensive order for a large size that, we believe, has ever been given in this country. These seamless pipes, even without coating, are more durable and are also, less expensive than the riveted pipes; but the company applies a patent enamel to them that, it is claimed, makes them almost indestructible, and, indeed, the company is willing to guarantee their durability for *any* length of time. The appended reports by Dr. S. DANA HAYES, Massachusets State Assayer and Chemist, and Prof. OTTO WUTH, of Pittsburgh, Pa., fully establish the claims of this pipe to durability. We commend it not only to our gas and water companies, but also to our mine owners and others who have to use or convey impure water, such, for example, as in many anthracite mines. These large pipes would make excellent screen shafts for our coal breakers, and the enamel would doubtless be of great advantage for coating the exposed iron work about the mines.

In bringing the matter to the consideration of "those whom it may concern," we believe we are doing consumers as well as manufacturers a service.

REPORTS.

"I have recently made a series of tests of your enameled pipe, for the purpose of ascertaining its value as a service pipe for conveying water and other fluids, and now submit the following brief report of the results obtained :—

"Portions of the enamel covering itself were first removed from several pieces and submitted to chemical analysis, to determine the presence of deleterious substances; but the results of these analyses are entirely negative, as there is nothing of this kind present. The pipe is made of wrought iron, covered, inside and outside, with an elastic, enamel-like material that does not contain any unwholesome or objectionable ingredients.

"Its durability was then tested, by exposing different pieces of the pipe to the solvent action of hard, soft, and sea waters, alcohol, and other fluids, for many days, and finally those fluids were boiled in the pipe for several hours in each case—the object of this boiling being to obtain, as nearly as possible, in a comparatively short time, the effect produced in the pipe by long-continued usage. These tests have been very complete, and I am quite suprised at the durability and power of resistance of the enamel covering determined in this way. It has not failed in any trial with natural waters in my laboratory, and it has withstood the action of boiling corrosive fluids for a longer time than specimens of other water pipes now in common use.

"I commenced this investigation with some doubts about your enameled pipe, but the severe tests which I have employed prove that it is perfectly harmless and possesses great durability, these being the properties of most importance in water pipe.

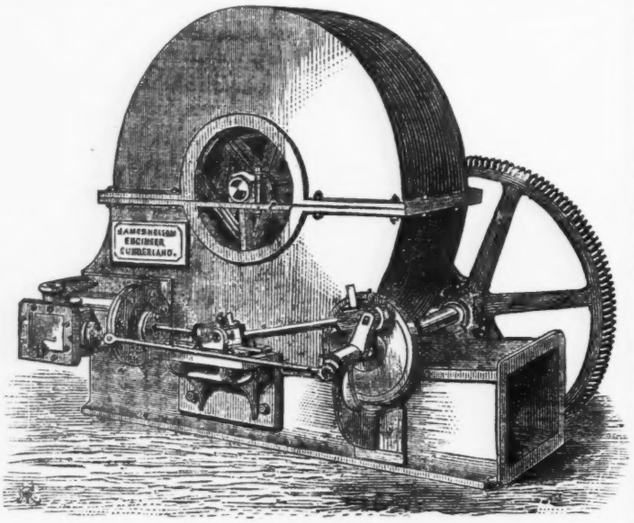
S. DANA HAYES,
State Assayer and Chemist, Massachusetts."

"I have made a complete series of tests in order to ascertain the quality of your

patent enameled pipe, and found that the enamel, covering perfectly both the inside and the outside of the wrought iron pipe, is not in the least affected by the action of alkalies, acids, salts of any composition, alcohol—in fact, any liquids which in practice are apt to be conveyed through the pipe. The enamel itself contains no deleterious substance whatever, and even if it did it would not make any difference, as not a trace of it will become soluble. Pipe so enameled is specially adapted for water and gas. O. WUTH."

Nelson's Self-Contained Guibal Ventilator for Mines.

THE Guibal fan is unquestionably one of the most convenient and effective ventilators that have yet been introduced for mine use, and its use is becoming quite general at our anthracite mines. We illustrate herewith a very compact arrangement for fans of moderate size; the design is an English one, by JAMES NELSON, of Sunderland. As will be seen, the chimney is horizontal instead



of vertical, and forms the bed-plate for fan and engine. As the engine drives through gearing it does not require to run fast. The whole machine is self-contained and needs no expensive foundations, either for fan or engine, and it is evident it could be applied to direct-acting as well as to geared engines. With small fans the casing is of cast-iron, as shown in the illustration.

Obituary.

PROF. SAMUEL D. TILLMAN.

PROF. TILLMAN, who was born in 1803 and died Sept. 4th, 1875, was a native of Utica, Oneida Co., N. Y. He graduated at Union College, and subsequently studied law at Canandagua; but about twenty years ago he came to New York and devoted himself to scientific and literary pursuits. Prof. TILLMAN was a prominent member of the American Association for the Advancement of Science. Soon after he came to New York, he became a member of the American Institute, was created a Professor of Science and Mechanics, and was subsequently elected Corresponding Secretary of the American Institute; he also acted as editor of the annual transactions of the Institute, published by the State, and was chairman of the Polytechnic Club, a position he held at the time of his death. But few men were more thoroughly informed in every department of science, invention and practical mechanical and general knowledge, and he left his mark on his time by the originality and ingenuity of his views on music and chemistry, on which subjects he published several monographs.

"What is Steel?"

Written for the ENGINEERING AND MINING JOURNAL, by H. M. HOWE, M. E.

CONCLUDED FROM PAGE 259.

AGAIN, as the burden of the confusion would rest on this generation in establishing the change, and but little on posterity, and as thus the change would be mainly for the benefit of posterity, we should weigh carefully the actual benefit posterity is likely to get by it. It certainly seems now as if the days of welded iron were numbered. Such great advances have been lately made in improving and cheapening the manufacture of homogeneous or cast wrought-iron and steel, and the attention of so many brilliant, intelligent, and experienced metallurgists is turned in this direction, that it seems probable that the uses of this iron will be continually increasing at the expense of those of welded iron, and that many generations will not pass away before welded iron is a thing of the past. Fusion improves iron very much for all, or almost all, purposes. The rapid increase of its use is only limited by the cost of producing it. The great success of BLAIR'S and SIEMENS' processes, of the Terre-Noire practice, and of PERNOT'S furnace, make it almost certain that cast ingots will soon be made as cheap as, and probably cheaper than, welded iron, if, indeed, they are not now.

If, then, welded iron is to be driven out of the market, or is to have only a limited field, the importance of distinguishing it concisely from iron which has been melted will be lessened. The importance of a short way of expressing a distinction depends greatly upon how frequently the distinction is to be expressed. If, on the one hand, welded iron is to be used for so few purposes, that, if iron were spoken of, it would be proper to infer that iron which had been cast was meant, unless the contrary was specified; and if, on the other hand, carburized and uncarburized iron are both to be very frequently used (as must necessarily always be the case, because there are so very many uses to which each one is put where it cannot be replaced by the other), then the relative importance of expressing concisely the distinction between welded iron and that which has been cast will be much less than it now is.

Probably with a view to lessening this confusion, it has been proposed to consider either the possession of the qualities conferred by fusion, or of those conferred by carbon, as sufficient to constitute steel; that is, to include all that was formerly called steel and all malleable iron which has been fused, much of which has not heretofore been classed as steel. This hybrid definition might possibly occasion less confusion than the one we have been considering, but in other respects it would be as bad, or worse. It would be quite as unnecessary, as there are a dozen ways of expressing homogeneousness as clearly and concisely as by the proposed pirating of the word steel. It would be classing under one head two entirely distinct classes of iron, of radically different, and of often opposite, uses and properties. In buying a steel rail, one might receive either a puddled laminated, carburized rail, that would split open at the welds, or a very soft uncarburized cast rail, which would flatten out of shape and quickly wear out. We would get neither the advantage of the old nor of the new classification; for, while under the old classification steel would clearly mean iron which could be hardened, and which was hard, strong, and resilient; and while, under the new definition, it would clearly mean iron which had been fused, under this hybrid definition it might be understood to mean either carburized or carbonless, welded or homogeneous iron. It would convey no definite information. Its meaning would be so very vague that it would be necessary to add to it always some word to indicate to which of the two very dissimilar classes of steel it referred.

The disadvantage of this vagueness has been keenly felt. A great deal of Bessemer wrought iron, very low in carbon, has been offered for sale as steel. Seekers of carburized iron have bought this, mixed indiscriminately with carburized iron, recognizing only the old meaning of steel, and found it weak, soft, incapable of hardening, and unfit for the purposes to which they put steel. From the repeated occurrence of this, and the uncertainty as to what sort of stuff you are going to get when you order Bessemer steel, people have come to think falsely that uniformity is unattainable in the Bessemer process, and to specify in ordering steel that it shall not be Bessemer steel; and that, too, in cases where properly carburized Bessemer steel would be perfectly appropriate.

Again, it is often asserted that it would be possible to discriminate more easily and more sharply between steel and wrought iron under the new classification than under the old one. Were it true, as I do not think it is, I do not see its importance. Classifications are based on important differences between the classes they separate, and not on the facility of distinguishing those classes sharply. Many of our most important classifications, such as those of matter into organic and inorganic; of organic matter into animal and vegetable; of animals into vertebrate and invertebrate; of men into honest and dishonest, friendly and inimical, good and bad; and of phenomena into chemical and physical, while they are based upon most important and radical differences, do not divide sharply the classes they form. In all these cases there are intermediate positions, near the line between the classes, where it is difficult to decide to which of them any particular object belongs. Yet who would think of objecting to the division of matter into solid, liquid and gaseous, on the ground that it was impossible to discriminate sharply between viscid liquids and solids, and between vapors and true gases? Who would propose to abandon this classification and apply the three names to some other classification, admitting of sharper lines of demarcation, but based on radically different grounds? The fact of matter being thus divided would be unaffected. You may take away the names of the classes, but you cannot destroy the classes themselves: you can merely make it inconvenient to express them.

But I believe that it is much easier to distinguish between steel and wrought iron under the old classification than under the one proposed. Any blacksmith, any machinist and mechanic of intelligence can tell readily whether iron will harden or not. But only an expert can decide whether iron has been cast or not, and in very many cases it is almost impossible to decide the question, even by costly experiments. If we adopt for convenience some arbitrary standard for discrimination, such as some fixed modulus of resilience, we shall thereby be able to discriminate sharply between steel and wrought iron in all possible cases, if we preserve the old classification. But, should we adopt the new, I see no possibility of such certain and sharp discrimination should the history of the iron in dispute be unknown, as must often occur.

Again, it is no doubt desirable to be able to discriminate briefly between homogeneous and heterogeneous iron, but it really seems entirely unnecessary to divert from its established meaning a word which has always been used to denote the presence of most important qualities, in no way connected with homogeneousness, in order to accomplish this end. There are many other ways in which the fact of having been fused can be expressed entirely appropriately, without causing any of the confusion which would follow the confiscation of the word steel for this purpose, without impairing the usefulness or efficiency of the word as heretofore employed, and, finally, as concisely and much more clearly and explicitly than it would be by the word steel. For instance, preserving the old meaning of steel, we can express the general classes of iron by the terms: 1. "Cast steel." 2. "Welded steel." 3. "Homogeneous wrought iron," or "Homogeneous iron," and 4. "Welded wrought iron," or "Welded iron." More explicitly we can say, "Puddled steel," "Puddled iron," "Blistered steel," "Bessemer steel," "Bessemer wrought iron, or iron," "Open-hearth *steel*," and "*iron*," or "*wrought iron*," or "*homogeneous iron*," "Uchatius *steel*" and "*iron*," or "*wrought iron*," "Crucible steel," and "Crucible homogeneous iron," or "Crucible iron," etc., and these indicate clearly and concisely whether the metal has been fused or not; whether it has the properties given by carbon or not, and, moreover, the process by which it has been made (a very important guide to its qualities).

If it were impossible to express the distinction between homogeneous and heterogeneous iron concisely and clearly in any other way than by the word steel, the question would arise "Is this distinction more important and useful than the distinction between carburized and uncarburized iron, which steel has always expressed? Is it of more importance to the millions of users, buyers, and sellers of iron to know whether a lot or kind of iron in question has the properties conferred by fusion than whether it has those conferred by carbon? Is it so much more important to indicate the presence or absence of the former set of qualities as to warrant us in appropriating for that purpose a word which, with its analogues, has been connected with such an entirely different set of qualities for three or four thousand years, so clearly, so intimately, and so uni-

versally as actually to have become synonimous with them?" To answer this, let us see which set of qualities affects its utility most.

Of the effect of casting on the mechanical properties of iron we know little. It alone perfectly removes scoria, and permits perfect continuity of contact among the particles of the metal. Although by great care in manufacture the amount of slag present can be made almost inconsiderable, in some cases, without actual melting, yet it can never be entirely removed. No matter how small a part of the surfaces of two adjoining particles may be separated by a thin layer of slag, (be it never so thin,) they cannot cling to each other with quite as great tenacity as if that slag were entirely absent.

In some cases freedom from welds is of the very first importance. This is especially the case where the finished article is of large cross section, as it is then impossible to expel the slag thoroughly from the welds, because the reduction of the size of the cross section during manufacture is almost necessarily slight; hence the working, which alone expels slag and brings continually greater and greater proportions of the surfaces of adjoining particles into actual contact, is slight too. Thus the difference between the tensile strength of large welded forgings and of the same iron reduced to small size is somewhat greater than the difference between the tensile strengths of weldless pieces of large and of small cross section forged from cast ingots.

In the same way it is easy to wring a handkerchief dry in the hands, while it is very difficult to squeeze the water out of a bale of cotton. Even if the particles of the different small slabs, before placed in the final pile, have been forced close together by great reductions of cross section, the reduction of that final pile must be comparatively small, if the product is to be of large section, and its component slabs must be poorly united. The superiority of cast metal is also especially great in cases where it is habitually subjected to severe sudden blows, which seem to be very trying to welds. In few, if any, cases is this superiority more prominent than in rails, which, besides being of large cross section, are continually subjected to the sudden impact of the wheels. (It is possible that, from great familiarity with this instance of exceptional superiority, engineers may consider the superiority of weldless over welded iron for ordinary purposes as greater than it really is.) For pieces of small cross section the difference in the value of welded and of homogeneous iron is not so great, as here we can render welded iron much more nearly homogeneous, and expel its slag much more effectually.

The tensile strength of welded iron practically free from carbon is from 18 to 30 tons per square in.; of similar homogeneous iron from 20 to 35 tons; of the strongest welded carburized iron about 50 tons per square in.; of the strongest homogeneous carburized iron about 60 tons. We have no reason to believe that casting increases the tensile strength of iron more than 15 or 20 per cent., all the other circumstances of composition and mechanical treatment being the same; or that it increases the resilience or the transverse, shearing or torsional strength in a greater degree. The fusibility, hardness, and power of hardening and tempering do not seem to be materially affected by it; while it seems to diminish slightly the ease of welding. I do not know that it has been shown to affect any other valuable properties of iron than these.

Carbon, however, as has been already pointed out, can double the elastic and ultimate tensile strength. It more than triples the hardness and the resilience; it increases the power of hardening more than five-fold; it lessens, and even destroys, the forgeableness and weldableness, and greatly lessens the toughness; it increases the fusibility in a most remarkable degree; it, at least, doubles the torsional, transverse, and shearing strengths.

Now, it seems to me that the difference between the behavior of carburized and uncarburized iron is more prominent, more important, and of greater effect upon the usefulness of the metal, than the difference between the behavior of welded and homogeneous iron. There are few, if any, uses to which homogeneous iron can be put for which welded iron of a proper degree of carburization could not be used, if prepared with great care, *i. e.* few uses where absolute freedom from welds and slag is a condition *sine quâ non* of efficiency, and where welded iron would be useless. For instance, though homogeneous iron is much better for boiler plates, rails, beams, springs, cutting and agricultural tools, yet properly carburized Swedes iron, double shear steel, cemented spring steel, or puddled steel, could be used for all these purposes with tolerable satisfaction. Conversely, there are few, if any, cases where welded iron cannot be replaced by homogeneous iron, except, possibly, where *very* great readiness of welding is needed.

Not so of carburized and uncarburized iron. For very many of the characteristic uses to which carburized iron is put—for example, springs, cutting tools, files, etc., etc., uncarburized iron would be utterly worthless. Conversely, for boiler plates, cold rivets, horse nails, clinch nails, etc., highly carburized iron would be worthless.

In brief, the properties of homogeneous and of welded iron are so closely alike, that the one can almost always fill the place of the other pretty well, while those of carburized and carbonless iron are so very unlike, that it is only comparatively rarely that they can fill each other's places satisfactorily.

It will here be urged, plausibly, that, with the old basis of classification, the name steel applied to a piece or class of iron does not of itself indicate to what extent it contains carbon and the properties which it gives; but that, with the proposed classification, based on homogeneousness, we express clearly that the iron in question has or has not been melted; that it is or is not strictly homogeneous. If it is steel, it is homogeneous; if it is not steel, it is heterogeneous. In short, that with the proposed basis of distinction the terms steel and wrought iron would convey information of a more precise kind than they do with the old basis. Let us see the real value of this objection. Under the old classification we divide all malleable iron into two classes. The one, wrought iron, has those qualities affected by carbon, on the possession of which the classification rests, to a tolerably uniform degree. The other, steel, has those properties in widely different degrees in different grades of steel, *i. e.* in steels of different degrees of carburization. But the same objection applies with equal force to a distinction based on homogeneousness and freedom from cinder. This would divide malleable iron into two classes, of which the one, steel, would have those qualities conferred by fusion to a practically uniform degree. But the other class, wrought iron, would have homogeneousness and freedom from cinder, on which the classification rests, in every possible degree, from the rough muck bar and the "nigger-head" bloom, which are exceedingly heterogeneous and full of slag, to Russia sheet iron and the almost absolutely homogeneous iron used for the best classes of wire, which are practically perfectly free from slag (piano wire is said to contain often 99.97 per cent. Fe.) Indeed, cast steel is probably less strictly homogeneous than would at first appear.

Though, when an ingot is cast it may be almost absolutely homogeneous, yet in the three or four heatings it may receive in the rolling mill its outside will probably lose its carbon, by oxidation, more rapidly than its interior will. We know that in the annealing boxes of malleable iron works the outside of the castings is decarburized much more rapidly than the inside.

It may be advanced, in like manner, that all malleable irons, that is all irons containing less than 2 per cent. carbon, which have been melted (which constitute the class steel of the proposed definition) indicate by the appearance of their fractures a greater similarity of structure than the fractures of the different classes of steel of the old classification do, which differ not only according to their degree of carburization, but also according as they have been melted or not. That, therefore, under the proposed classification, the different varieties of steel would be more closely alike in structure than under the old classification.

But the proposed change would be only robbing Peter to pay Paul. The mechanical properties of wrought iron (which are probably much surer indications of the true structure than is the appearance of the fracture, which depends so greatly upon the manner in which the fracturing force is applied) under the old classification are closely alike. But the new classification which would crowd boiler-plate iron and puddled steel wire rods, Swedes iron and shear steel, spring steel and horse nails, all into the class of wrought iron, would thus create a class having vastly greater differences of structure, (whether we judge from the appearance of the fractures of its components, or from their mechanical properties) than exist in any of the three classes, wrought iron, steel and cast iron, of the old classification.

En resumé, the proposed classification, based on fusion, has no warrant in custom. Its adoption would occasion great and useless confusion. Its different classes would not be as easily distinguished from each other as are those of the old classification. It would not divide malleable iron into classes as distinct from each other, possessing each as uniformly the qualities on which the classification is based, or distinguished from each other by as important characteristics, as are the classes of the old classification, based on the possession of the qualities which carbon, etc., gives.

While fusion greatly improves iron for most purposes, its effect is much less marked and important than that of carbon. Hence, were we precluded from expressing conveniently and briefly *both* whether iron had been melted or not, *and* whether it contained a notable amount of carbon or not, and had we to choose *which* it would be most desirable to indicate, we should choose the latter. If this be true, how foolish it would be to attempt to obliterate this latter more important classification by seizing the words which have for thousands of years, in all civilized languages, been used as the names of its classes, and applying them to a much less valuable classification based on fusion, for expressing which there are so many concise, easy and appropriate ways, which would cause no confusion.

The plan of making steel include both the steel of the old classification, and the steel of the proposed one, while it might occasion slightly less confusion, would be still less worthy of adoption, for it would have the advantages of neither of these classifications and the disadvantages of both.

Remarks on the Combustion of Smoke in the Furnaces of Steam Boilers.

READ BY M. EMILE BURNAT AT THE SESSION OF THE SOCIÉTÉ INDUSTRIELLE DE MULLHOUSE, OCTOBER 27th, 1858.

Translated for "THE ENGINEERING AND MINING JOURNAL" by Chief Engineer B. F. ISHERWOOD, U. S. Navy.

CONTINUED FROM PAGE 264.

AT Sarrebruck, the apparatus for the manufacture of lampblack gives only 33 lb. of carbon from every 1000 lb. of coal used. In this case, the gases of combustion escaping from the chimney are almost wholly deprived of the carbonaceous particles which are deposited in the different chambers of the apparatus where the combustion is effected, and where it is made as smoky as possible. I have, then, concluded that if I estimate at 3 per cent. the quantity of carbon escaping from a chimney when the smoke is at the blackest, and at 2 and 1 per cent. respectively when the smoke is in the two other conditions previously described, I should certainly be above the truth.

Our scientific colleague, M. PENOT, has been so obliging as to furnish me with the sheets of a course he delivers at the High School of Applied Mechanics, and in them I find a method for determining the loss due to imperfect combustion which, applied to the analyses of M. DEBETTE, cited in the Memoir of M. COMBES, gives the following results:

The resumé of seven of these analyses shows:

1st. *In the case where the smoke is black and thick*, it contains in 100 volumes, 11 of carbonic acid, 7.2 of oxygen, 1.55 of carbonic oxide, and 0.58 of hydrogen; the remainder being nitrogen.

2d. *In the case where the smoke is lightly colored*, 8 of carbonic acid, 12.9 of oxygen, 0.18 of carbonic oxide, and 0.93 of hydrogen.

3d. Finally, *in the case of colorless smoke*, M. DEBETTE shows 10.86 of carbonic acid, 11.48 of oxygen, no oxide of carbon, and only 0.33 of hydrogen.

Let us now take up the *first case* and estimate the total quantity of heat which has been produced.

11 volumes of carbonic acid weigh:	11	$\times 1.5291 = 16.820100$
1.55 volume of carbonic oxide weighs:	1.55	$\times 0.9673 = 1.499315$
0.58 volume of hydrogen weighs:	0.58	$\times 0.0692 = 0.040136$

Now, a weight of 16.820100 of carbonic acid contains a weight of 4.5873 of carbon which in burning produced $4.5873 \times 14544 = 66717.6912$ Fahrenheit units of heat.

A weight of 1.499315 of carbonic oxide contains a weight of 0.856752 of carbon which in burning produced $0.856752 \times 4451.4 = 3813.7458$ Fahrenheit units of heat.

To ascertain the quantity of heat generated by the combustion of the hydrogen, we must determine the weight of that element as follows: We have adopted a coal containing 5.5 by weight of this gas for 83 of carbon. Now we have ascertained there are 4.5873 of carbon contained in the weight of carbonic acid in 100 volumes of the smoke, and 0.856752 of carbon in the carbonic oxide, making a total of $4.5873 + 0.856752 = 5.444052$ of carbon. We shall have then $5.5 : 83 = x : 5.444052$, whence $x = 0.3607504$ of hydrogen. The combustion of $0.3607504 - 0.040136 = 0.3206144$ of this gas generated $0.3206144 \times 52490.6 = 16829.2422$ Fahrenheit units of heat

The total quantity of heat generated has then been $66717.6912 + 3813.7458 + 17441.5516 = 87360.6792$ Fahrenheit units.

Let us now estimate the quantity of heat which has been lost. First, that which results from a portion of the carbon having been transformed into carbonic oxide instead of carbonic acid, and consequently having generated per unit of weight only 4451.4 Fahrenheit units of heat instead of 14544, making a

difference of 10092.6 units of heat, and causing a loss of $0.856752 \times 10092.6 = 8646.8552$ units of heat.

Then, the not burned weight 0.040136 of hydrogen, caused a loss of $0.040136 \times 52490.6 = 2106.7627$ Fahrenheit units of heat; making the total quantity of heat lost $8646.8552 + 2106.7627 = 10753.6179$ Fahrenheit units.

According to these calculations, the total quantity of heat that should have been generated, is $87360.6792 + 10753.6179 = 98114.2971$ Fahrenheit units; of which the quantity lost was $\frac{10753.6179 \times 100}{98114.2971} = 10.96$ per centum. To this figure it is proper to add the 3 per centum admitted loss of carbon, and we shall have a total loss of about 13.96 per centum for the imperfect combustion accompanied by black smoke.

By operating in the same manner with *the second case*, we shall find:

8	volumes of carbonic acid weigh..	$8 \times 1.5291 = 12.232800$
0.18	volume of carbonic oxide weighs..	$0.18 \times 0.9673 = 0.174114$
0.93	volume of hydrogen weighs.....	$0.93 \times 0.0692 = 0.064356$

Now a weight of 12.232800 of carbonic acid contains a weight of 3.3362 of carbon, which generated in burning $3.3362 \times 14544 = 48521.9837$ Fahrenheit units of heat.

A weight of 0.174114 of carbonic oxide represents 0.09999379 of carbon which generates in burning $0.09999379 \times 4451.4 = 445.1124$ Fahrenheit units of heat.

We have then $3.3362 + 0.09999379 = 3.43621379$ of carbon, which, for the same coal, gives $5.5 : 83 = x : 3.43621379$, whence $x = 0.2277$ of hydrogen. The combustion of $0.2277 - 0.064356 = 0.163344$ of hydrogen generates $0.163344 \times 52490.6 = 8574.0246$ Fahrenheit units of heat.

In this case the total number of units of heat generated has been $48521.9837 + 445.1124 + 8574.0246 = 57541.1207$.

There have been lost by the transformation of a portion of the carbon into carbonic oxide $0.09999379 \times 10092.6 = 1009.1973$ units of heat.

Since 0.064356 weight of hydrogen escaped combustion, there were thus lost $0.064356 \times 52490.6 = 3378.0850$ units of heat.

The total loss is then $1009.1973 + 3378.0850 = 4387.2823$ units of heat.

The total quantity of heat that should have been produced is then $57541.1207 + 4387.2823 = 61928.4030$ units, of which the loss was $\frac{4387.2823 \times 100}{61928.4030} = 7.08$ per centum, to which must be added 2 per centum loss due to the carbon in the smoke, making a total of 9.08 per centum.

Finally, *for the third case*, namely, that of a colorless smoke, we shall find:

10.86	volumes of carbonic acid weigh....	$10.86 \times 1.5291 = 16.606026$
0.33	volume of hydrogen weighs.....	$0.33 \times 0.0692 = 0.022836$

A weight of 16.606026 of carbonic acid contains a weight of 4.5289162 of carbon, which generates in burning $4.5289162 \times 14544 = 65868.5572$ Fahrenheit units of heat.

We have here 4.5289162 of carbon, which indicates $5.5 : 83 = x : 4.5289162$, whence $x = 0.3001089$ of hydrogen, of which $0.3001089 - 0.022836 = 0.2772729$ in burning generated $0.2772729 \times 52490.6 = 14554.2209$ Fahrenheit units of heat.

The total quantity of heat generated in this case is then $65868.5572 + 14554.2209 = 80422.7781$ Fahrenheit units.

Now, there was only lost the weight 0.022836 of hydrogen, which in combustion would have generated $0.022836 \times 52490.6 = 1198.6753$ units of heat.

The total quantity of heat that should have been produced is then $80422.7781 + 1198.6753 = 81621.4534$ units, of which the loss was $\frac{1198.6753 \times 100}{81621.4534} = 1.47$ per centum, adding to which the 1 per centum due to the carbon in the smoke, we have 2.47 per centum for the loss in the case of colorless smoke.

To sum up, and accepting the data hereinbefore given, we find that out of every 100 minutes there were 10 minutes during which the loss of heat relatively to the total quantity that should have been developed was 13.96 per centum; and 60 minutes during which it was only 2.47 per centum. Whence results that the loss arising in the furnaces of steam boilers from the incomplete combustion of coal accompanied by the disengagement of smoke more or less deeply colored, can be estimated at an average of, say, 5½ per centum of the total quantity of heat that would have been generated on the grate, had the combustion been perfect.

If it be admitted that there could be attained in practice the prevention of only the loss during the time the smoke was nearly colorless, we should find approximately the above figure reduced to, say, 3 per centum.

I say approximately, for calculations of this kind rest necessarily on data more or less arbitrary. The analyses whose results I have taken are not sufficiently numerous—in fact, M. COMBES' memoir contains only seven complete ones for the gas from coal-burning furnaces; the author, being principally interested in the determination of the quantities of carbonic acid and oxygen, often neglected to ascertain the proportions of the other gases.

Be that as it may, I believe the fact should be admitted, imperfect as is the presentation I have made, that the loss of economic effect in the furnace of a steam boiler, due to the imperfect combustion under the ordinary methods used. is, in reality, of but little importance; and that there is but slight probability of realizing any appreciable benefit from its diminution, while to radically avoid it is impossible.

Assuredly, the problem of smoke-burning furnaces is a very interesting one, but to prevent illusion it is necessary to show that it is only of value in view of public health and cleanliness, and that if we desire to obtain any important economy of coal we must commence by removing from the boiler other causes of waste more considerable than this.*

In conclusion, I will cite two examples of smoke-burning apparatus which I have had occasion to try. The results I ascertained go to prove the correctness of the foregoing explanations.

One of the apparatus in question is well known, and can be found described in all the recent works on this subject; it is M. BEAUFUMÉ's apparatus. M. G. DOLLFUS and myself have been able to follow the experiments made during three months at the factory of M. M. DOLLFUS-MIEG & Co.

M. BEAUFUMÉ has put in practice and perfected notably a system which is certainly not new, for M. PÉCLET mentioned it fifteen years ago (1843) in his Treatise on Heat, and attributed its discovery to MM. THOMAS and LAURENT. The principle consists in first converting the combustibles into carbonic oxide and carburetted hydrogens in a special apparatus, and in then burning these gases by means of particular arrangements in the furnace of an ordinary steam boiler. M. BEAUFUMÉ generates the gas in a plate-iron box surrounded with water; a sort of locomotive furnace. MM. SAURET and LANGLOIS, who have recently submitted their system to the Society for examination, employ nearly the same process, save that their gas generator consists of a brick furnace. They thus loose a part of the radiant heat from the combustible. This is the sole notable difference which appears to exist between the two apparatus. These two systems should be equally smoke-burning; the first, in all cases, gave no appreciable smoke.

The apparatus experimented with at Dornach being constructed exactly like those whose designs have been recently reproduced in several publications, it is inferable that since 1855, the time at which the experiments herein referred to, were made, there have been no essential modifications. Now the engineers who conducted for M. BEAUFUMÉ the experiments made at the factory of MM. DOLFUS-MIEG, & Co., have not obtained at the maximum more than 5.6 pounds of steam per pound of coal, (the feed-water being reduced to 32 degrees Fahrenheit); an economic evaporation which the same boilers give with an ordinary furnace. It is, therefore, very difficult, in the face of this result, to explain those which have been published in several accounts in which the statement is made of 10 to 12 pounds of steam evaporated per pound of coal. Furthermore, the apparatus is costly, of a problematic durability, and of a very complicated management. Nevertheless, it could be made of real utility in burning combustibles of a kind that could not be consumed on a grate in the ordinary manner, which was well understood by M. PÉCLET. But to affirm, as is often done, that this system gives an economy of 50 per centum, and more, over ordinary boilers, is an error which should be corrected.

Another experiment that I recently had ocasion to make, was with another apparatus which burned the smoke equally well, and in a very complete and curious manner. The process consisted simply in the employment of a jet of steam in the furnace, by means of a tube placed along the front of the grate and pierced with holes on the side of the fire. This steam-pipe ought to be opened only when the grate is freshly charged, and left so during the time that black smoke is ordinarily produced.

The idea of a steam-injector, either above or below the grate, is very old. I have found it frequently, and under many forms, in the various publications concerning smoke-burning; and it is singular to see the contradictory affirmations which have been advanced on the subject of this process. Let them be as they may, the following is what I found as the result of a series of experiments made on this system.

The furnaces to which it was applied were nearly complete smoke-burners, but it did not appear that *when they were in proper condition* the economy was sensibly increased. There was even a loss* which in the experiments made by me rose to 8 per centum, and which, with a negligent fireman, might become very sensible.

The effects produced by this injection of steam, appear to result from the following two circumstances. First, at the moment when the tube is opened, there is a sensible increase of the draught. Thus, the mean of a dozen trials made with and without the apparatus, shows that in the first case there pass into the ashpit 227.8 cubic feet of air per pound of coal burned, and in the second case only 198.3 cubic feet; these figures are the means of trials repeated during four days. It would seem to follow that the steam projected into the furnace more intimately mixes the gases from the fuel and thus causes their more complete combustion. This apparatus is very simple, but little costly, of very easy management, and could be used with advantage over many other systems, in the case where it was necessary to enforce smoke-burning by legislation. I would add that in some cases it does not appear impossible for it to give a slight economy, as such is affirmed to be found with furnaces having a very strong draught.

Pumping Engine with "Hydraulic Rods,"

AT THE SULZBACH ALTENWALD COLLIERY, NEAR SAARBRÜCKEN.

By H. PFAEHLER.

(Zeitschrift für das Berg, Hütten und Salinenwesen, xxii., part 3 and 4, pp. 179–190.)

THIS is an arrangement for the transmission of power from a steam-engine at the surface, by a column of water circulating under pressure, instead of the ordinary reciprocating rods, the circumstances of the case not allowing of the establishment of a direct-acting steam-pump underground. The mine, which belongs to the Prussian Government, is sunk to 306 yards below the surface. The motor established at the surface is a double-acting horizontal high-pressure engine, with a cylinder 53 inches in diameter and 61·5 inches stroke. The piston-rod is connected at either end with pressure plungers of 9 inches diameter, making the same stroke as the steam piston, each of which is brought into connection with the pumping engine underground by a tube filled with water. This underground engine consists of four pressure pumps, arranged in pairs, and connected by a cross-head. They are put in motion alternately by the pressure pump at the surface, through the intermediate agency of the hydraulic tubes. The diameter of these plungers is 6 inches, and their stroke 66 inches. Between each pair is placed the working plunger of one of the mine pumps, reduced from 12 inches to 10 inches in diameter, to diminish the pressure. In order to bring these pumps into action, the engine at the surface is made to act,

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* The conclusions of M. COMBES in the memoir cited, on the burning of smoke, are the following: "Our experiments seem to demonstrate that the employment of the smoke-burning processes or apparatus do not in any case economise the fuel. But the experiments made at the marble yard, etc., show that by a judicious use of these processes and apparatus we can prevent the smoke *without increasing the expenditure of fuel.*"

We have recently received a work of the greatest interest: it is a memoir on the Combustion of Coal, read by Mr. GRAHAM, on the 23d of February, 1858, to the Literary and Philosophical Society of Manchester. Speaking of smoke-burning, the author says: "We have obtained this result by means of an excess of air; the loss resulting from which has been a little above one per centum. This loss is easy to understand if we take into consideration the relatively very small weight of black smoke. The following experiments give some facts on this subject.

"I had in view the heating of a copper washing-tub belonging to a laundry, by means of hot air drawn from the flues of a furnace. I drew the hot air and smoke from the principal flue by a pump and forced them into an intermediate washing vessel in which mechanical means were used for dividing the air current and directing it into the tub. The results of these experiments are not given as regards the heating of the tub. . . . . [Here follow detailed explanations of this fact] but I thus had the means of estimating the weight of black smoke. The hot air employed came from furnaces which gave off deeply colored smoke every time they were freshly charged. The washing apparatus intercepted the soot so perfectly that the water contained in the copper tub was found not to be colored at the end of the trial. I carefully examined the black residuum and compared its weight with that of the total fuel burned. *I found the weight of the black smoke did not exceed the millionth part of the latter.*"

There results from this experiment that we should estimate much too high the loss due to the carbon in considering it at 1.5 per centum for an average.

* Taking account of only the water vaporized in the two cases, and without including the expenditure of steam for the injection, which was not much.

by means of one of the pressure plungers, upon the water in one of the rod tubes, which transmits the effort to the corresponding pair of pressure pumps underground, and the working plunger in connection is put in motion, either aspirating or forcing water according to its position, the opposite pair acting conversely. The water is forced into an air-vessel, and thence through the rising main, 303 yards in height, in one lift to the surface. On the change of the stroke the water in the cylinder of the press pump rises in the second rod tube, and follows the retiring pressure plunger at the surface, the power supplied by the descent of water in one column being sufficient, with the exception of a slight allowance for friction, to effect its return in the other. The two pumps underground have a common rising pipe, 8 inches in diameter; and if the cataract pauses of the engine at the surface are not too long, the discharge is practically continuous.

For the sake of regularity and safety in working, the hydraulic connections, or rods, must be kept completely filled and free from air. For this purpose a special safety and filling apparatus is placed before each pressure pump at the surface, consisting of a chamber with an auxiliary feed valve, a safety valve, and an air escape valve which is in connection with a closed cistern at a higher level, kept constantly filled with water. If, in consequence of loss of water, a partial vacuum is formed behind the pressure pump, the feed valve is opened by the pressure of the water in the reservoir and the deficiency is made up. The safety valves, which are loaded by springs, are intended to relieve any excess of pressure that may arise on the water in the rod tubes. The water escaping in such a case passes into the feed cisterns. In setting the engine to work difficulty was at first experienced in adjusting the relation of the stroke of the pumps underground to those above. To effect this a magnetic telegraphic apparatus was used, and signals were transmitted until the two engines were in proper relative positions. It was difficult, however, to obtain a proper transmission of the motion until all the air contained in the water in the rod tubes had been expelled. The pressure columns, or rods, are cast-iron pipes of 5-inches internal diameter and 1·5-inch thick, put together in 10-feet lengths, with flange joints and leather packings, which were found to be preferable to india-rubber.

All the tubes were proved by hydraulic pressure to 100 atmospheres. The working pressure on the underground pumps, due to the difference between their areas and those of the pumps at the surface, with the necessary addition for friction, is 50 atmospheres, which, added to the hydrostatic head of 27 atmospheres, in the rods, gives a total working pressure of 77 atmospheres, or about 1,155 lb. to the square inch. As the engine has only been recently set to work, it has been experimented on with great caution, and has not been driven at a higher speed than six double strokes per minute, at which rate, in spite of the tolerably long cataract pauses, the delivery at the top of the rising main is in a continuous, though not quite uniform, stream. The engines, both above and below ground, at this speed, are remarkably quiet and steady in working.

The cost of the engine, which was built by the Cologne Engine Works Company (Kölner Maschinen Fabrik), was as follows:

1. Engine above ground	£1,537
2. Engine under ground	1,413
3. Chamber for pumps	210
4. Hydraulic rod tubes	1,215
5. Rising main pipes	588
6. Screw bolts	168
7. India-rubber	19
8. Wrought-iron work	400
	£5,550
Cost of erection and all masonry and other work underground and in the shaft	3,567
Total cost	£9,117

Note by the Translator.—This system of driving underground machinery by water pressure transmitted from a steam-engine at a distance, has been adopted to a considerable extent by Mr. DARLINGTON, who calls it a "water bar." At the Phenix mine, in Cornwall, an arrangement, consisting of a plunger attached to the main pumping engine, connected by a length of tube with a water-pressure engine in another shaft, has been at work for the last ten years. This and similar applications of the principle seem to have been overlooked by the author of the paper when he claims for the builders of this engine the priority of application. H. B.

On the Occurrence of the Brown Hematite Deposits of the Great Valley.*

By Prof. FREDERICK PRIME, Jr., Lafayette College, Easton, Pa.

THE Great or Cumberland Valley, which (under a variety of names) extends from Canada, through Vermont, Massachusetts, Connecticut, New York, Pennsylvania, Maryland, Virginia and East Tennessee, to Alabama, is composed in part of limestones lying immediately above the Potsdam sandstone. Geologically, they belong to the era between the Potsdam and Trenton, and are commonly termed Calciferous. A peculiarity of these limestones is their great richness in limonite or brown hematite ores, which form a large part of the charges of the many blast-furnaces situated on their outcrops. The mines from which the ores are obtained are (properly speaking) only pits or quarries, from which the ore is extracted by means of picks or shovels, powder never being employed.

The ore does not occur casually at any point in the limestone, but forms regular lines, following apparently the outcrops of certain beds. In Lehigh County, Penn., where I have been engaged on the Geological Survey of the State, during the past season, there are three or four of these lines. During the progress of the survey I was much struck by the fact that the two most important and promising lines of outcrop were—one, at the base of the crystalline schists (forming the South or Lehigh Mountain), and overlying the Potsdam sandstone conformably; the other, near the line of junction of the Calciferous limestone with the Hudson River slates. The mines along these two lines—following the topography of the country—were in place, richer and more permanent than those of the belts between, which had been more decomposed *in situ* and were generally leaner.

A peculiarity of these two lines of outcrop, and one to which I particularly desire to draw attention, is the occurrence of what I at first mistook for a highly altered slaty limestone, but which, on subsequent analysis, proved to consist in great part of damourite (hydrated potash-mica). The following are analyses of this damourite-slate:

I. From Fogelsville, Lehigh County, within a few hundred feet of the contact of limestone and slate, by Dr. F. A. GENTH.

II. From Hensingerville, Lehigh County, within 300 feet of gneiss, by Mr. SYDNEY CASTLE, of the University of Pennsylvania.

III. From Allentown, Lehigh County, within 150 feet of contact of the limestone with Potsdam sandstone, by Mr. PEDRO G. SALOM, of the University of Pennsylvania.

IV. From another quarry close to III; also by Mr. SALOM.

	I.	II.	III.	IV.
Silica	49·92	45·40	59·30	39·80
Carbonic acid	....	....	....	14·40
Ferric oxide	0·91	5·06	30·30	2·40
Alumina	34·06	24·69		23·95
Ferrous oxide	....	....	....	trace
Magnesia	1·77	13·56	trace	1·94
Lime	0·11	trace	trace	9·85
Soda	0·74	0·27	1·51	0·52
Potash	6·94	5·85	6·24	3·34
Water	6·52	4·80	4·70	6·00
	100·97	99·63	102·05	102·20

As typical damourite contains 11·77 per cent. of potash, it is evident from the above analyses that I. contains 55·40 per cent. of damourite; II., 49·70 per cent.; III., 53·02 per cent.; and IV., 28·30 per cent. The remainder of the slate consists of ferruginous clay, quartz, and carbonates of lime and magnesia.

I have noticed that, as a rule, the fresh damourite-slate can only be observed where a mine is being worked; when fresh, it is white to straw-yellow in color, has a greasy feel and very slaty texture, being composed of minute crystalline plates. As soon as work is stopped in a mine the slate commences to decompose and becomes rapidly converted to a white or yellow clay, the latter color being due to oxide of iron. Indeed, in many mines no slate can be observed at all, the whole of it being changed to clay prior to the opening of the pits.

I have made a qualitative examination of both white and yellow clays from the same mine as I. and close to the spot where the slate was obtained. I found them to contain the same ingredients as I.

That the damourite-slate belongs to the Calciferous and not to the Laurentian or Huronian periods, is evident from the fact that it is found forming a bed in the limestone immediately overlying the Potsdam sandstone and conformably to the latter. The ore is always found above the clay or damourite-slate, or at least in the upper portions of it, *never* below it; and usually in streaks or masses precisely in the manner noticed by Prof. W. P. BLAKE* at Ocoya Creek, California; and from the manner in which the ore occurs it appears to have been deposited by the percolation of waters containing iron in solution. The ore also occurs as so-called "bombshell ore," and this ore, when hollow, either contains water or the clay resulting from the decomposition of the damourite-slate. The interior surface of this bombshell ore is frequently glazed, apparently by a thin coating of manganese oxides, and often contains small stalactites, the ore clearly indicating its aqueous origin, and its formation *subsequent* to the rock or clay inclosing it.

So-called pipe ore is also found—though more rarely in this district—but under different conditions, being always found underneath a bed of limestone, and evidently formed by the percolation of ferruginous water through this bed. I have never seen the pipe ore in large quantities at any one point or associated with the slate or clay.

If this occurrence of the damourite-slate or clay and ore was merely local, it would be scarcely worth noticing; but in fact we find that the slates or clays are almost universally associated with the iron ores of the Calciferous epoch. They are, therefore, of the greatest importance.

Professor DANA, in a private letter to me, mentions the occurrence of slates with the brown hematite deposit of Richmond, Berkshire County, Massachusetts. Professor SHEPARD,† in writing of the ore bed at Kent, Connecticut, speaks of decomposed micaceous gneiss (?) called by the workmen "gray fuller's earth," and also of "decomposing quartzy mica-slate." We meet with this association of slate or clay and ore in Lehigh County, Penn.

Professor LESLEY also speaks of this occurrence in his "Report on the Brown Hematite Deposits of the Nittany Valley, Penn." Here there are apparently *three* lines of mines, to judge from the map accompanying the report. Professor PERSIFOR FRAZER, Jr., informs me that he found the same association of white clay with ore in York County, Penn.

Professor LESLEY‡ gives a sketch of what he calls "ore-bearing slates" lying between the Potsdam and Calciferous of the Cumberland Valley. These are evidently damourite-slates, for he proceeds in the article to speak of white clays formed by their decomposition. The same association is found in Maryland and Virginia, in the valleys forming the Great Valley.

Professor LESLEY‖ speaks of the occurrence of white clay with ore in the same formation at Embreeville, East Tennessee. It also occurs at Shelbyville, Alabama.

It is therefore evident that the occurrence of this slate or clay with the brown hematite ores of the Calciferous epoch is the rule, its absence the exception. As Professor LESLEY‡ says: "They (the ores) never occur in any other relationships. They are the same ores, in the same rocks, arranged in the same way, the whole distance from Massachusetts to Alabama. Consequently, what is geologically true of the ore beds at Salisbury and Amenia, east of the Hudson, is true all the way to Alabama."

Formerly the slates probably covered the sides of the mountain ranges now forming their south boundary, resting on crystalline limestone, which separated them from Potsdam sandstone. On account of the large amount of carbonate of lime which the slates probably contained, and the ease with which they were converted to clay, they have suffered the most in the erosion which has taken place. My own experience has been that the slate and clay occur under the ore, and *not* the reverse.

From this constant occurrence of the slate with the ore it is evident that the former has exerted an important influence on the deposition of the ores; and I think that the presence of the slate was necessary to such deposition, in that it formed an *impervious bed through which the chalybeate waters could not percolate.* Whatever may have been the manner in which the ore originally existed, it was deposited in and above the slates from an aqueous solution. Under these circumstances, it will be highly improbable that we shall find continuous de-

* A paper read before the American Institute of Mining Engineers at New Haven, Feb. 25th, 1875.

* See Pacific R. R. Reports, vol. v, p. 168.

† A Report on the Geol. Survey of Connecticut, by C. U. SHEPARD, p. 20.

‡ Proc. Amer. Phil. Soc., May, 1872.

‖ LESLEY, "The Iron Ores of South Mountain in Cumberland Co., Penn." in Proc. Amer. Phil. Soc., Jan,, 1873.

posits of the brown hematite ores when the slate or clay does not occur with them.

With respect to the quantity of ore, Professor LESLEY, in his paper on the Cumberland Valley, says it will depend: "First, on the original charge of iron in the strata; second, on the dip of these strata; and third, on the depth beneath water-level to which the mouldering decomposition of the strata and the peroxidation and concentration of the iron has extended."

There is much difference of opinion as to how these deposits of brown hematite ore can have been formed. Dr. HUNT, in a paper read before the National Academy of Sciences, in November, 1874, gives it as his opinion that they were once beds of pyrites in *Huronian* schists, now decayed. I have shown in the commencement of this paper that they are *Calciferous* slates or schists; and were they ores formed by the alteration of pyrites *in situ*, we should find kernels of iron-pyrites which had escaped alteration, especially in the deepest mines. This is not, however, the case. Iron pyrites are found very rarely; as, for example, in Breinig's mine, near Allentown, and one of the Glendon Iron Company's mines near Easton; and these mines are not the deepest we have, the former being quite shallow.

Professor LESLEY* thinks the ores "were deposits *in loco originali* of the iron (as hydrated peroxide) set free from the limestone or dolomite rocks during their gradual erosion and dissolution;" agreeing in this respect with Dr. R. M. S. JACKSON, who made the first geological survey of the Nittany Valley ore beds in 1838 or 1839. Of course, only the carbonates of lime and magnesia would be dissolved; the clay, iron and silica would remain behind. Were this, however, the case, should we find *fresh, undecomposed* damourite-slate conformably in position with limestones above and below it, as can be seen at the Lehigh Iron Company's limestone quarry at Allentown, Penn.? From what I have seen in Lehigh, Northampton and Berks Counties, Penn., I have been led to the following conclusions, which I advance with considerable reluctance, as I consider it extremely dangerous to argue from observations within a limited area to general conclusions.

The damourite-slates, being the product of the decomposition of primary rocks containing orthoclase and, probably, oligoclase, or albite, were deposited in the Silurian sea during the Calciferous epoch and near its commencement. At Allentown and Bethlehem, Penn., the slates are from 50 to 100 feet above the Potsdam sandstone, with a blue massive limestone, generally crystalline, between the two. Limestone was again deposited above the slate. I am not yet prepared to say whether more than one bed of damourite-slate was formed, and reserve an opinion on this point until I have made further explorations.

The brown hematites were probably formed by the oxidation of iron pyrites, but the former are not in the same place that the latter were. My reasons for this assertion are twofold. In the first place, the animal carbon of the organisms, whose shells formed the enormous quantity of dolomite or limestone, exists in such quantities throughout the limestone as to color the rock, the zinc blende (of Friedensville) and the carbonate of iron a bluish-grey. This same carbon would readily reduce the sulphate of iron carried into the ocean to iron pyrites. As a proof of this reduction I need only mention that iron pyrites have been found in the mud† of a pond. Secondly, the great majority of the brown hematites which I have had analyzed, and they are many, contain a *trace* of sulphur, usually not more than a few hundredths of a per cent. I have also found minute (almost microscopic) crystals of iron pyrites in much of the limestone, where it is opened in quarries; and I have also seen in much of this same limestone, where weathered, minute cavities, which I have ascribed (perhaps erroneously), from their general appearance, to the decomposition of the pyrites.

It is at present impossible to say whether the pyrites from which the brown hematite ores were and are forming were thus minutely disseminated through the limestone, or whether there was a bed of the limestone—now decomposed,—especially rich in the pyrites.

In either case it would seem that the pyrites above water-level—and we must bear in mind the great erosion which the surface of the country has undergone since it was formed—would oxidize from the action of the water and the air carried in by it, forming protosulphate of iron. This being readily soluble in water, was carried down through the limestone, forming sulphate of lime (gypsum) and carbonate of iron wherever the solution came in contact with the fresh limestone. This reaction was, however, probably slight, owing to the rapid descent of the solution in seeking the water-level. It experienced no difficulty in its descent until it came in contact with the damourite-slate, when, meeting with an impervious bed, it could not descend any further and was then obliged to follow the slates. This considerably retarded the rapidity of its flow, permitting the reaction between the limestone (and the carbonates of lime and magnesia in the damourite-slate) and protosulphate of iron to take place more completely. By this means carbonate of iron was deposited, being but slightly soluble; while the sulphate of lime (gypsum) formed, being very soluble, was carried off in solution.

No doubt, many of the limestone caves—so common in the Calciferous limestones—were formed by the dissolving action of the water containing protosulphate of iron. The subsequent formation of the limonite is easily explained, being merely the oxidized and hydrated product of the carbonate of iron.

In fact, a bed of blue carbonate of iron, identical in appearance with the ordinary limestone and Friedensville zinc-blende, occurs with the brown hematite ores at Balliet's mine near Allentown and at one of the Hellertown mines near Bethlehem. It does *not* occur at many of the mines in the Lehigh Valley; those being the only mines where I know of its occurrence. The very fact of this occurrence would tend to show that the above-mentioned reaction has taken place and was the one by which the ore was formed. This reaction would also explain why the brown hematites which occur in limestone are almost always free from sulphur, merely containing a trace; and yet almost always containing *this trace*. As a proof of this, I give the analysis of a brown hematite which occurs at Katahdin Furnace, Piscataquis County, Maine. The analysis was made by Professor T. M. DROWN, of Lafayette College. It afforded

Ferric oxide.	Water and organic matter.	Silica.	Sulphuric acid.	Phosphoric acid.
76·87	19·25	0·71	3·10	0·10=100·03

Professor DROWN informs me that the rock underlying the ore was siliceous in character, thus giving the sulphuric acid no opportunity to combine with lime and be carried away.

The objection may be raised to this view of the case, that we do not anywhere find any deposits of gypsum. It must be borne in mind that gypsum is readily soluble, and would be carried a considerable distance in solution before being precipitated. I can also point to one very considerable deposit of gypsum in this formation; that of Saltville in Russell County, Virginia.

* LESLEY, Report on the Brown Hematite Deposits of the Nittany Valley.
† GMELIN—KRAUT's Handbuch der Chemie, 6th ed., vol. iii, p. 333.

It may be urged—and I confess with much show of reason—that the iron was first present in the limestone as carbonate. As one example of this may be adduced the following instance, for which I am indebted to Professor DANA. "In one of the brown hematite mines at Richmond, Berkshire County, Massachusetts, there was exposed, about fifteen months ago, a great mass of massive carbonate of iron, which was once a part of the limestone of the region. It appeared to have resisted decomposition in consequence of its compactness and purity. There is limonite of great thickness all about it, which has been made by the decomposition of the limestone and its included carbonate of iron, or its carbonate of iron and lime; for an extensive ledge of limestone rises above the great pit or excavation on its north side, whose layers are comformable to that of the massive carbonate of iron in the bottom of the mine. The material between the two must have originally been calcareous: it is now gone and there is limonite in its stead."

The fact here mentioned tends to prove that the limonite was probably originally present as carbonate of iron and that the outer and possibly less compact portion of the deposit became changed.

It seems to me that in this instance, as in those at Balliet's mine and Hellertown, we have a case of alteration of the limestone to carbonate of iron, particle by particle, or, so to term it, "a pseudomorph by replacement."

My objection to the original deposition of the carbonate of iron, as such, in the Calciferous epoch is threefold. In the first place, it should be uniformly distributed through the limestone and not confined merely to the horizon just above the damourite-slates. Then there should not be even the *trace* (the few hundredths of a per cent.) of sulphur in the brown hematites, which we so uniformly find. And finally, there seems to be a lack of cause, such as exists in the case of the carbonates of lime and magnesia For these were secreted by the marine animals to form their shells, etc., which would not be the case with carbonate of iron.

In conclusion, I would once more point to the fact that whatever the origin of brown hematites may have been, the cause of their deposition, where they are now found, must have been the damourite-slates.

DISCUSSION.

DR. STERRY HUNT remarked that the question of the origin and mode of occurrence of iron deposits about the base of the Paleozoic rocks along the great Appalachian Valley is a very complex one, and must be considered with reference to the whole Paleozoic basin, although the points raised in the paper of Prof. PRIME have reference only to certain ore-beds found in close proximity to the Auroral limestones of Pennsylvania, and generally referred to the Primal slates of ROGERS. He proceeded to remark upon the well-known fact of the presence of sheets or nodular masses of iron ores interstratified in the Paleozoic rocks of the Appalachian basin from the coal measures downwards. In the coal formation, besides carbonates and limonites, derived from their alteration, there is found anhydrous red oxyd or hematite, deeply buried in the measures under such conditions as lead us to regard it as an original deposit. He referred, moreover, to the interstratified deposits of limonite or brown hematite at the summit of the Pre-meridional or Lower Helderberg limestones, and in the lower part of the Scalent or Saliferous limestones besides the great fossiliferous red hematite or dyestone ore of the Surgent or Clinton, so widely spread throughout the Paleozoic basin, and the red hematite found in lenticular masses in the white Levant or Medina sandstone. All of these he conceived to have been derived by solution from ferriferous, siliceous, and argillaceous sediments, by a process similar to that by which bog ore is now formed. From the great mass of such material which made up the Oneida and Medina formations, came the iron for the horizons of the Clinton and the Lower Helderberg.

Descending in the series, we reach the Auroral limestone (No. II.) in which, following LESLEY, we here comprehend everything from the base of the Calciferous to the summit of the Trenton. With this great limestone group are associated extensive deposits of brown hematite ores, which are supposed by LESLEY to be of posterior origin, and to have been formed by the accumulation of the iron set free by the decomposition of the accompanying strata, the magnesian limestones of which contain, by GENTH's analyses, a not inconsiderable quantity of carbonate of iron. The oxyd set free from the decay of such rocks is at all times subject to resolution and deposition in the form of limonite.

Beneath these limestones occurs another horizon of brown hematite ores, distinguished by LESLEY as the slate-crop banks. On these the ore is in layers, interstratified with beds of soft clayey matter. frequently white and unctuous, the whole formation often much corrugated and at high angles. These ores, according to LESLEY, are the result of a decomposition by infiltrating waters of ferriferous strata, which he assigns to the Primal slates of ROGERS, supposed to occupy a position between the Calciferous sand-rock and the Potsdam sandstone. These slates, as decay went on are conceived by LESLEY to have slipped downwards, and become corrugated by the weight of their own mass. (Proc. Amer. Philos. Society, Jan. 3, 1873.) The ores of these slates, which are thus described as occurring in the Cumberland Valley, at the foot of the South Mountain, in Pennsylvania, are by LESLEY compared with the beds of brown hematite ore which occur along the western border of New England, and which he conceives to have the same origin and geological character.

At this stage of the inquiry I wish to call attention to the fact that some, at least, of these deposits to the northward belong not to the uncrystalline rocks of the Paleozoic basin, but to the more ancient crystalline schists of Eozoic age. This was long since noticed and described by Prof. C. U. SHEPARD, in his report on the Mineralogy of Connecticut, in 1837, (pp. 17, 20 and 146.) Of the well-known ore deposits of Salisbury and Sharon, in that State, it was there said that "the ore is disposed in vast beds with a stratification every where obvious and perfectly conformable to that of the adjoining mica-slate. It is, moreover, free from secondary aggregations." In the town of Kent, again, the ore forms parellel highly inclined layers, interposed in a decomposed micaceous gneiss locally known as fullers' earth. In some localities in this region, the ore presents secondary aggregations from solution and re-deposition, and appears as the cement to a breccia containing fragments of the adjacent quartzose strata. It was suggested by SHEPARD that the source of these ores is to be sought in the decomposition of sulphuret of iron and other ferriferous minerals, and he says "it is obvious that in a majority of instances the change took place in the original repositories of these minerals." Similar observations are reported to me by Prof. JAMES HALL, as seen in Richmond, Massachusetts, and in Columbia, New York, where the limonite ores occur in mica-schist, and a like case has recently been observed near the western base of Hoosac Mountain. There, as I have described in my recent report to the Corporation of the Hoosac tunnel, the highly inclined strata of gneis and mica schist are decomposed to a considerable depth, the feldspar of the rock being changed into a clay, and the whole mass so softened as to be excavated with spades. It is clear, I think, from a study of the region, and a comparison of it with the universally decayed condi-

tion of similar crystalline strata further southward in the Blue Ridge, that the decayed rock at the western base of the Hoosac Mountain is but a portion which has escaped the general erosion that has left on the higher levels of the mountain rounded and grooved surfaces of the hard undecomposed rock. The Hoosac Tunnel was driven through this decayed rock. At a distance of 600 feet from its western entrance, and at 200 feet from the surface, the decay of the gneiss rock was still complete, but at 1000 ft., where the tunnel is 280 ft. from the surface, some portions of rock were found but partially decayed. At a distance of more than 1200 feet, a bed of brown hematite ore was met with, and Prof. HALL has observed the outcrop of this bed from the gneissic rock in the flank of the mountain where it has a thickness of from four to six feet.

These limonites noticed by SHEPARD and by HALL offer close analogies with those which occur among the decayed crystalline rocks of the Blue Ridge, from Southern Virginia to Georgia and Alabama, and are well known to be the outcrop of great veins or beds of sulphurets of iron, generally more or less cupriferous. These gossans are there often worked at the surface as ores of iron, the origin of which is clearly like that maintained by SHEPARD for the limonites of Western Connecticut, namely, the alteration *in situ* of beds or veins of pyrites.

It is hardly necessary to recall the fact that the various crystalline rocks of the great Appalachian belt abound in pyrites, often interbedded in great masses or disseminated or interlaminated. It is also to be noted that of these crystalline rocks the Huronian series occasionally includes beds of carbonate of iron and others of magnesite and dolomite abounding in carbonate of iron, sometimes with much carbonate of manganese. From the decomposition and oxidation of these various minerals, whether sulphurets or carbonates, hydrous oxide will result, and hence we should expect to find them wherever these decayed rocks have escaped erosion.

It was with these various facts and considerations before me that I had, last October, an opportunity of seeing one of the slate-crop ore deposits near the base of the South Mountain, the Ziegler Mine, in the vicinity of Fogelsville, Pa. The strata, as exposed in the ore pit, are nearly vertical, and some of the soft and argillaceous beds with which the limonite is interstratified consist of a tender, unctuous, micaceous substance resembling closely many of the so-called talcose schists of the Huronian, which I long since showed to consist in large part of hydrous mica. The whole aspect of the deposit led me to suspect that we might here have a portion of ancient crystalline strata decayed *in situ*, and this was confirmed by the knowledge of the fact that Dr. GENTH had found the unctuous mineral associated with the limonite in similar ore beds to contain a large portion of a hydrous potash-mica, damourite. This opinion I ventured to express in a communication to the National Academy at Philadelphia, in November last, and it is to this that Prof. PRIME has alluded in his paper. It would be presumptuous in me to generalize from a single case or to assert without further examination, that these underlying and decayed ore-bearing strata are not Paleozoic; but the analogy between this deposit and those in New England and elsewhere, where similar ores occur in decayed crystalline schists, makes me very desirous to pursue further the investigation. The Primal slates are wanting in parts of the Appalachian Valley, where the over-lapping Auroral limestone, as in many localities to the northward, in New York and Canada, reposes directly upon the older crystalline rocks, the Potsdam (or Primal) being altogether absent, or represented only by local and inconsiderable deposits. There can be no doubt of the great antiquity of the commencement of this softening and oxidation of the crystalline rocks; and I believe it will be found that portions of these strata, thus altered in early Paleozoic time, which then escaped erosion, are still preserved under the shelter of the Auroral limestones, and have been, in some cases, mistaken for the wanting Primal slates.

REMARKS BY PROF. PERSIFOR FRAZER, JR.

The suggestions contained in Prof. PRIME's paper are very valuable, and show a state of things in Lehigh County very analogous to that observed in York County. The work of the party of the S. E. District of the Second Geological Survey of Pennsylvania has been comprised within the belt of country which stretches from Wrightsville and Marietta Furnace, York County, in the N. E., to Littlestown, in Adams County. The slates composing the formations of this part of the State overlie the mica schists and gneisses, which cross in a S. W. direction into Maryland east of the York County boundary. These slates are for the most part chlorite slates, sometimes alternating with chloritic gneiss and quartzite, and passing (in a direction *across* the measures and with the preponderating dip N. W.) into hydro-mica slates containing chlorite, then into hydro-mica slates without this mineral.

This latter is the character of the slates immediately underlying the Auroral limestone; but in most cases these slates are very much weathered, and sometimes sufficiently to obscure both cleavage and bedding planes where they pass into the clays which distinguish this particular horizon.

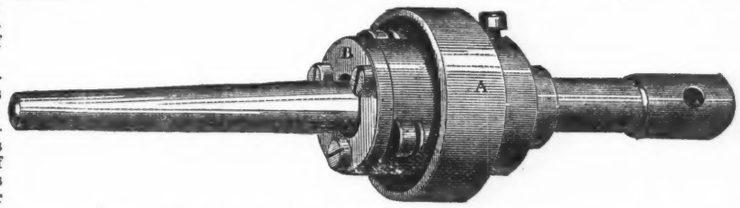
My own observation confirms all that Prof. PRIME says in relation to mode of occurrence of the limonites of this horizon; their proximity to the lower edge of the limestone basin; their association in the yellow, blue, and white clays, etc.; but I am not prepared to accept the theory of their production from pyrite disseminated in the overlying limestone. The law governing the deposit of this ore is well studied along the margins of the two groups of limestone which enter York County from the N. E.; and wherever an edge of this calcareous deposit is exposed within the boundaries of the basins, it is almost uniformly accompanied by its limonite belt. The angles of dip are usually quite sharp, and the strata very much folded within the area represented on the old geological map as a uniformly *blue* (*i. e.* limestone) basin. If a line be traced through the points on the map which represent banks actually mined, or places where ore is known to exist, that line will quite nearly mark the limits of the Auroral basin. The view expressed by Prof. PRIME, as to the agency of these clays produced by the weathering of the mica slates, in retaining the solutions of iron by virtue of their impermeability, and allowing the ores to segregate, must be adopted by all who have an opportunity of observing the facts.

Can Companies Collect Store Bills from their Employees?—The men in the employ of the Lehigh and Wilkes-Barre Coal Company, at Treskow, brought suit before Esquire SHUTTER, of this borough, on Saturday last, for the recovery of the amounts deducted from their month's wages, for store accounts, &c. The Company confessed judgment for the amount of moneys retained for the doctor and priest, with interest, amounting to over $2,000, but demanded credit for the store accounts, which they claimed they had purchased for a consideration. The justice gave judgment against the Company for the amount of store bills from the 15th of the month, the date the men claimed to have given notice to the company demanding their pay in full. The case will be carried to court for adjudication.—*Hazleton Sentinel.*

Dudgeon's Roller Tube Expander.

THIS useful and ingenious tool is well known, among machinists, as probably the most efficient tube expander made; indeed, its advantages are so fully recognized, that large numbers have been sent to England and elsewhere. As many as ninety were recently sent to England on one order.

By their use tubes can be expanded without striking a blow on them, thus



rendering them far less liable to crack; leaky ones can be tightened, with steam on the boiler, with perfect safety. One Expander will answer for any thickness of Tube Sheet, by simply shifting the position of the outside ring, A, thus avoiding the necessity of an expander for each different thickness of sheet. They are no more liable to break than the common tool, and are much more easily kept in order, as the rollers are the only thing that can give out, and they can be replaced in a few moments by unscrewing the cap, B.

Mr. DUDGEON's address will be found in our advertising columns.

New Method of Treating Mixed Copper, Silver, and Gold Ores.

AN extension of the HUNT & DOUGLAS copper process, so as to make it applicable to the production of gold and silver, was recently patented by Messrs. DOUGLAS, HUNT & STEWART, and the success which has attended its practical application has been very satisfactory. That the presence of copper in solution as chloride assists the extraction of silver from its ores is a fact which is well known and taken advantage of; but the peculiarity of the new process consists in using with the salt a solution of neutral protochloride of iron instead of copper pyrites or bluestone. Both chloride and dichloride of copper convert the sulphuret of silver into chloride of silver, but their use as reagents in the extraction of silver has hitherto been limited by their cost; if, however, these chlorides of copper can be obtained from the copper ores which are often mixed with the ores of silver, an important reagent is obtained without cost, while the copper is saved and becomes a valuable bye product instead of being objectionable. To secure these advantages, Messrs. DOUGLAS, HUNT & STEWART treat silver ores containing copper with a bath of protochloride of iron, which reacts with oxide of copper, giving rise to chloride and dichloride of copper, the latter of which, like chloride of silver, though unsoluble in water, is soluble in brine. The essential features of the new process are the choice of suitable ore, and the grinding, calcining, and chloridising of it; the treatment of the oxydised or chloridised ore with a solution of protochloride of iron and salt, in order to dissolve out the copper and most of the silver, and the precipitation in the metallic state of the copper and the silver thus dissolved; the lixiviation of the sands thus deprived of their copper and part of their silver, with hyposulphite of lime to extract the remaining silver, and the precipitation of the silver thus dissolved by sulphide of calcium; and, if gold be present, leaching the sands exhausted of copper and silver with chlorinated brine and the precipitation of the dissolved gold from this by sulphuretted hydrogen or sulphide of calcium.

In this method of extracting silver the only reagent consumed is the protochloride of iron. The advantages of the system are numerous. In chlorinating in the furnace silver ores containing base metals, such as zinc and lead, a more perfect chlorination is effected by mixing them with ores holding copper and iron, and subsequent treatment with the bath of protochloride of iron. All the copper is recovered at a slight cost. As much copper is extracted from unroasted copper ore or regulus as is contained in the state of protochloride in the solution from the roasted ore, and unroasted silver-bearing ores or regulus may be decomposed by this solution containing chlorides of copper. The metallic silver is obtained perfectly free from base metals by the precipitation with copper, the silver left undissolved in the residues yielding a much purer amalgam than if the roasted ore had not been previously treated with the bath. Gold, if present in the ore, is left in the best condition, either to be chlorinated or to be amalgamated with the chloride of silver remaining in the residues. By the removal of the base metals before amalgamation, a saving of mercury is effected. A great saving of salt is effected through the recovery by evaporation of the chlorides usually thrown away in the waste liquors. In treating simple ores of silver, or ores of silver containing but little base metal, as lead or zinc, the costly operation of roasting with salt may be dispensed with, and the unexpensive protochloride of iron may be used to produce the chloride of copper necessary for their treatment.

With regard to the importance of the recovery of salt in the ordinary method of chloridising silver ores, it will suffice to mention that in STEWART's silver mine in Colorado it was found that 26,258 gallons of liquor were run off daily from the settlers, which had a specific gravity of 12° Beaumé, and contained per gallon 6,072 grs. of soluble chlorides There were thus lost 2,263 lb. of chlorides, chiefly chlorides of sodium and zinc (which was found as suitable a chloridiser as pure salt,) whose recovery would reduce the consumption of salt more than one-half. It appears that at Ore Knob Copper Mine, N. C., they obtain by the HUNT & DOUGLAS process from a copper pyrites dressed up to 5¼ produce 2,100 lb. of copper for $77, or at the rate of 35 cents per lb. To permit an estimate being formed as to the practicability of making the process remunerative elsewhere, it may be stated that the prices paid were for 7 cords of wood, $7; to 21 men, at seven furnaces, at $1 = $21; to four men charging furnaces and tanks, and four emptying tanks and removing residues, at 75 cents = $6; to two men attending tanks, $2; foreman, $2; chemist, $3; for 525 lb. of salt, $6.56; and for 1,470 lb. of iron at 2 cents = $29.40; making $79.96 in all. The furnaces are simple and inexpensive in construction, and require about 25,000 bricks each. The tanks cost complete about $60 each, and the labor employed need not be skilled nor high-priced, as the ordinary laborers of the country can in a short time be trained to the routine of the work. Both the copper and the mixed ore processes appear well worthy of a trial in this country, and there can be little question that in the hands of competent men it could be made very remunerative.—*English Ex.*

Discovery of Large Coal Beds Near Evanstown (Wy. T.)

A CORRESPONDENT to the *Record Union*, Sacramento, reports the following. [The usual discount on the thickness of the beds will, we presume, be allowed for instant belief.]

"The mine is situated in Uintah County, Wyoming Territory, about twenty-five miles east of Utah, and eighteen miles northwest of Carter Station on the Union Pacific Railroad, and has been appropriately named the Mammoth Sandstone Mountain Coal Mine. It was discovered by Mr. CROCKER, of Logan, Utah, from information he received from an old Indian, who showed him a piece of fine-looking coal which he found while hunting. He offered to show Mr. CROCKER the place if he would give him $10, which offer was readily accepted. The Indian then took him about fifty miles to a spot about five miles from the mine, which Mr. CROCKER found by tracing the vein the Indian pointed out to him.

"The mine is in a sandstone mountain, about four and a half miles long, running north and south, facing east, and about three quarters of a mile across; the mountain dipping suddenly at each end. There are sixteeen veins of coal in sight; the bottom one is the smallest, being five feet; the next is the largest and most easy of access, and is upwards of seventy feet thick; the next above is sixty feet; another of forty feet; another of about thirty feet; five of about twenty feet each, and five of sixteen feet each. The last one is about twelve feet—althgether about four hundred feet of coal, four and a half miles long; in fact, it may be surely termed a mountain of coal.

"The veins lay at an angle of 22°, with ledges of white sandstone intervening. The coal is very bright, is perfectly free from slate or dirt, and is said to be cannel coal. A small quantity of the croppings from the 70-foot vein has been tested for coke, by JOHN MCVICKER, an assayer of Salt Lake City, who states that it yields coke fifty-two and two-tenths per cent., which may be considered a very excellent return, under the circumstances.

"When it is considered that very large quantities of coke are shipped from Pennsylvania to Utah and Nevada, a distance of 2,000 miles, at a cost of $35 to $40 per ton, for the purpose of smelting silver ores, it will at once be seen of what immence value this mine is likely to prove to owners of low grade silver mines. Professor PONTEZ, of Omaha, geologist to the Union Pacific Railroad, has made an investigation of the mine, and reports it as the finest deposit of coal in Western America."

The following is an extract from Prof. C. PONTEZ's report:—

"I have just returned from a remarkable discovery of coal, vast in quantity, apparently excellent in quality, and easily mined, which merits further examination. The deposit is situated in the same valley in which oil wells have been sunk, near Aspen, on the Union Pacific Railroad, about eighteen miles further north. The seams are found between a series of terraces of sand-stone in the nearly perpendicular face of a detached range or hog's back three and a half miles long, half a mile wide, and, I judge, seven hundred feet high. In front, eastward, is a level plain. Approaching by this plain the face of the range presents a series of nearly parallel horizontal stripes, commencing at the base and continuing to the summit. Arriving at the base, one is surprised to find that the distant stripes are a series of sand-stone terraces, gradually receding upwards, until lost in the curve of the brow of the hill. The thickness of each terrace is from forty to sixty feet; the intervals between are filled with seams of coal; the first is forty feet thick, the next thirty feet, that above sixty feet, and so on until the apex is reached. In the aggregate there must be from two hundred to three hundred feet vertically of coal, pressed on by a mass of sand-stone of like height. The sand-stone of the first seam has a dip of forty degrees West; the strike is north and south; the west side shows no outcrop of ledges. The enormous pressure this coal has been subjected to should render it very dense."

We think Prof. PONTEZ will find the thickness of the beds considerably less than he here estimates, since these thicknesses are the intervals between the beds of sand-stone. Doubtless the beds of soft shale and fire clays that usually accompany the coal are included in these dimensions, and will be found by no means "filled with seams of coal." Nevertheless the discovery is very important, especially to the Union Pacific Railroad, to which the development of extensive mines would contribute largely.

Michigan School of Mines.

THE School of Mines, which was created by act of the last Legislature, will issue its first annual announcement in a few day. The faculty will consist of ten professors, and five instructors. The appointments to the different chairs have already been made, with the exception of the departments of general chemistry and physics which are not yet filled. The chair of mining engineering, geology and mineralogy has been assigned to WM. H. PETTEE, formerly of Harvard. The Detroit *Free Press* of the 26th ult. gives the following particulars.

Examinations of candidates for admission to the school will commence September 23d.

It is intended that the regular course of study shall cover four years, but candidates may be admitted to advanced standing, if properly qualified, at any time prior to beginning of the fourth year. The studies of the freshman and sophomore years are very nearly the same as those pursued by students in civil engineering. In the junior year the mining engineer will be engaged with the following studies: Qualitative chemical annalysis, in the laboratory, with class work in chemical reactions and problems; quantitative analysis with application to metallurgy; the theory, adjustment and use of surveying instruments, with field practice, and drawing of plans and profiles; analytical mechanics, drawing, etc. In the senior years the following course will be pursued:

Quantitative analysis. Blowpipe analysis. Assaying. Class work in the study of chemical manufactures. Lectures on metallurgy; principles of smelting and slags, fire proof material, fuels; problems in calorific power and calorific intensity; processes for copper, lead, silver, gold; iron smelting, pig iron, bar iron and steel. Mineralogy and geology. Lectures on machinery and motors. Machine drawing and mechanism. Lectures on mining operations.

The University already possesses ample means for illustrating all the various branches of instruction which are closely allied to the special topics of mining, engineering and metallurgy. The mineralogical cabinet contains about 8000 specimens. The geological cabinet contains 40,000 specimens, illustrating the subjects of geology and paleontology. The chemical laboratory is fully equipped, and has accomodations for nearly two hundred students. The supply of chemical and physical apparatus for experimental illustration is very large.

In addition to these faculties, the Legislature has apportioned a liberal sum for the purpose of fitting up an assaying and metallurgical laboratory, and for procuring drawings and models of furnaces and mining machinery. Steps have also been taken toward the formation of a metallurgical cabinet. Contributions to this collection are earnestly requested from the friends of the University and of this school.—*North Western Mining Journal.*

Splendid Blast Furnace Practice.

No. 2 STACK of the Bay Furnace made during the week ending August 22, 264½ gross tons of pig metal, of which 224½ tons was No. 1, 35¾ tons No. 2, and 4¼ tons No. 3. The ore used was 64 per cent. of New York mine red specular, and 36 per cent. McComber hematite, the average consumption of coal being 102 bushels, and the yield of ore 60.40 per cent. This lacks but a trifle of being an average of 38 tons per day, and is four tons in the aggregate better than the work of the Fayette furnace. A month's run at the same rate would beat the celebrated Scotia furnace by at least 200 tons, and as an earnest of what the furnace can do we are promised 275 tons the present week, and some of the owners are ready to wager $1,000 on her ability to score 300. It must be remembered that this is only a 45-foot stack, 9½ feet across the boshes, and that it has not yet reached its maximum of production, having only been in blast since May. There is nothing extraordinary or peculiar about the construction of the furnace, and its unexampled achievement may be credited entirely to the superior management of the local agent, Major H. S. PICKANDS.

We challenge the world to produce a furnace of the same size that can make a better showing.—Marquette *Mining Journal.*

To the above Mr. PICKANDS adds a table of the running of the furnace for each day of August, from which the following figures are deduced:

Total No. of charges	3,770
Total pounds of ore charged	4,120,550
Total bushels of charcoal	113,100
Product in gross tons No. 1 iron	915¼
" " " No. 2 "	185¼
" " " No. 3 "	8¾
Total tons	1,109¼
Average yield of ore	60.31
Bushels of coal per ton of iron	101.98
Average make per day	35.78

Proportion of ore used—64 per cent. specular and 36 per cent. McComber hematite.

The product for the seven consecutive days, beginning the 19th and ending the 25th, was 276½ gross tons, which we believe to be the largest week's make yet attained by a charcoal furnace.

Selected List of Patents Recently Issued,

RELATING TO MINING, METALLURGY, GAS MAKING, ENGINEERING, ETC.

Reported for the "ENGINEERING AND MINING JOURNAL" by LOUIS BAGGER & Co., Counsellors at Patent Law, Washington, D. C.

Truss Bridges, W. M. BLACK, Lancaster, Ohio.

An upper chord is combined with a catenarian arc, composed of sections or sets of eye bars, united by hitch plates and radial compression posts, and diagonal tension bars, by which the different strains are distributed. The lower chord is suspended by sets of diverging bars connected to said hitch plates.

Furnaces for Smelting Ores, W. E. C. EUSTIS, Milton, Mass.

Air and combustible gas are forced through ore and pig metal, and the products of combustion are conducted through similar charges which thereby become heated and reduced.

Fluxing Compositions, A. PARAT, San Francisco, Cal.

This consists of a mixture of sulphate of soda or potash and pulverized charcoal.

Distributing Quicksilver in Quartz Mills, M. P. Boss, Virginia City, Nev.

Quicksilver is forced by water pressure up into an elevated tank, and is thence distributed through measuring vessels to the amalgator, thence will charge the settlers and a strainer, and back to the elevated tank.

Devices for supplying Steam Blast to Furnaces, E. J. JONES, Indianapolis, Ind.

Steam is supplied through pipes having tapered ends, and longitudinal openings. The area of the opening is regulated according to the amount of end pressure brought to bear upon the pipes.

Ore-Washers, L. D. STEPHENS, Gold Run, Cal.

A sluiceway provided with a false bottom is separated from the bottom washer by a grating, through which the finer particles of ore, etc., fall. The false bottom serves as a cover, protecting the valuable contents of the sluice from depredation.

Stamp Mill Feeders, J. WALKER, Sonora Cal.

The table revolves with the hands of a watch; sudden motion is imparted to it from the stamp shaft as it descends by the conical pulley thereon, lever on the stamp frame, intervening pulleys, and weighted rope, which acts by friction on the table shaft, while recoil is prevented by friction of the ore, ratchets and pawl. Ore is fed to the table by the hopper, and passes around until deflected by adjustable guide pieces to the apron.

NEW PUBLICATIONS.

NOTES ON CERTAIN EXPLOSIVE AGENTS: By WALTER N. HILL, S. B., Chemist, U. S. Torpedo Station, Newport, R. I. 8vo. sewed, $1 00.

CONTENTS: *Explosions and Explosive Bodies; Nitro-Glycerine, its Composition, Properties, Manufacture, Storage, Transportation and Use; Dynamite and Dualin; Gun-Cotton, its Composition, Formation, Properties, Modes of Use and Relative Force; Picrates and Fulminates; General Composition of Explosive Mixtures; Comparative Remarks on the Use, Handling and Effect of Nitro-Glycerine and Gun-Cotton.*

Published by JOHN ALLYN, Boston. For sale by D. VAN NOSTRAND.

A little book containing a vast amount of information of the greatest interest to all using explosives.

Notes.

Manufacture of Gas for Lighting and Heating Purposes and Apparatus.—This invention consists in the manufacture of gas in carbon, then carburetting this gas with hydrocarbon vapor, and passing the carburetted gas through a red hot retort; also in a method of setting the retorts, in which two or three horizontal gas retorts are connected one above another, with only one gas outlet leading to the hydraulic main from the combined retorts; when using three retorts the gas from the lower retort must pass over the coal placed in the upper retorts, or the gas from the upper retort, before escaping, may be forced downwards over the coal in the lower retorts. - *J. Kidd, 24, Martins' Lane, London.*

Selenetic Plaster.—A plaster which offers many advantages, is prepared by STUART & Co., of Edinburgh, from a mixture of hydraulic lime, gypsum and siliceous sand, any hydraulic limestone of fair quality is calcined and mixed with about five per cent. of dehydrated gypsum; after grinding to a powder this is then made into mortar with five or six parts of clear sharp sand and without hair. When laid on as a plaster this cement sets, dries and hardens in twenty-four hours, and a second coat can be put on in the course of the following day, and houses thus plastered are fit for immediate habitation. It is also impervious to moisture and never breaks or blisters as in the case of imperfectly slacked limes. Its cost in Edinburgh was not greater than ordinary mortar.

Shipments of Iron and Ore from Lake Superior.—The following table will show the total shipments, in gross tons, from the Lake Superior iron district for the season up to September 8, 1875, and those for a corresponding period last year:

IRON ORE.	1874.	1874.
From Marquette	319.068	336,723
From Escanaba	193,005	169,253
From L'Anse	65,748	49,786
Total	577,824	555,762
PIG IRON.		
From Marquette	18,741	20,639
From Escanaba	9,693	11,710
From Green Island	8,018	6,695
Total	36,722	30,044

STATISTICS OF COAL PRODUCTION.

This is the only Report published that gives full and accurate returns of the production of our Anthracite mines.

Comparative Statement for the week ending Sept. 11:

	1875.		1874.	
	Week.	Year.*	Week.	Year.
Wyoming Region.				
D. and H. Canal Co	57,526	2,181,437	54,731	1,621,287
D. L. and W. RR. Co	64,519	2,402,313	48,283	1,679,284
Penn. Coal Co	27,026	936,133	29,756	908,821
L. V. RR. Co	21,503	635,507	15,258	674,215
P. and N. Y. RR. Co	1,661	76,298	1,595	42,386
C. RR. of N. J	53,496	786,296	36,947	916,483
Penn. Canal	16,684	161,910	10,310	228,600
Lack. and B. RR	..	81,493	..	112 529
	242,415	7,262,493	196,910	6,213,605
Lehigh Region.				
L. V. RR. Co	88,930	1,006,893	73 137	2,202,957
C. RR. of N. J	27,584	321,651	31,211	752 495
D. H. and W. B. RR	1,607	52,650	813	28,040
	118,121	1,381,202	105,161	2,983,492
Schuylkill Region.				
P. and R. R. RR. Co	174,880	2,567 897	147,348	3,308,249
Shamokin & Lykens Val.	27,243	836,862	26,334	628,645
	202,123	3,404,759	173,682	3,936,894
Sullivan Region.				
Sul. and Erie RR. Co	..	5,557	582	26,550
Total	562,659	12,051,011	476,335	13,160,541
Increase	86,324	..	..	..
Decrease	..	1,106,530	..	..

* Year beginning January 1st.

The above table does not include the amount of coal consumed and sold at the mines, which is about seven per cent. of the whole production.

The following Table does not give the entire production of our Bituminous mines, but it is by far the fullest report published.

The Production of Bituminous Coal for the week ending Sept. 11, was as follows:

Tons of 2,000 lb., except where otherwise designated.

	Week. Tons.	Year. Tons.
Cumberland Region, Md.		
Tons of 2,240 lb	59,°30	1,593,233
Barclay Region, Pa.		
Barclay RR., tons of 2240 lb	7,776	219,177
Broad Top Region, Pa.		
Huntingdon and Broad Top RR	2,534	148,366
*East Broad Top	341	30,939
Clearfield Region, Pa.		
*Snow Shoe	305	44,682
*Tyrone and Clearfield	5,935	562,195
Allegheny Region, Pa.		
*Pennsylvania RR	1,061	152,539
Pittsburgh Region, Pa.		
*West Penn. RR	1,812	142,980
*Southwest Penn. RR	675	8,827
*Penn. & Westmoreland gas coal, Pa. RR.	7,086	437,164
*Pennsylvania RR	3,223	274,170
Kanawha Region, W. Va.		
Chesapeake and Ohio RR	3,598	111,845

* To Aug. 31. † Sept. 4.

The Production of Coke for the week ending Aug. 31.

Tons of 2000 lb.	Week. Tons.	Year. Tons.
Tyrone and Clearfield	..	273
Alleghany Region	..	53
West Penn. RR	885	31,455
Southwest Penn. RR	4,736	352,284
Penn. & Westmoreland Region, Penn. RR.	209	21,733
Pittsburgh, Penn. RR	960	69,042
Total	6,790	477,840

The receipts at Port Richmond for the week were 85,000 tons, shipments 40,000 tons, and balance on hand 135,000 tons.

The decrease of shipments of Cumberland Coal over the Cumberland Branch, and Cumberland and Pennsylvania Railroads amounts to 58,520 02 tons.

The Exports of Coal from Baltimore for the week were 000 tons, and for the year, 28,890 tons as compared with 61,658 tons to the corresponding time in 1874.

Receipts of coal at Boston, for week ending Sept. 10, and year from September 1st, 1875.

From	Week. Tons.	Previously Tons.	1874. Tons.
Alexandria and Georgetown	2,350	112,142	112,781
Philadelphia	9,786	532,166	597,108
Baltimore	300	170,277	243,905
Other places	3,806	259,577	210,696
Great Britain	--	3,397	4,146
Nova Scotia	400	31,195	80,604

Belvidere Delaware RR. report:

	Week.	Year 1875.	Year 1874.
The receipts of coal at Coal Port (Tr'ton)	9,119	81,500	196 314
" " " South Amboy	14,769	135,775	449,186
Shipments of Coal Port (Trenton)	8,308	78,348	196,056
" South Amboy	11,695	189,172	442,363

Shipments from Pictou, N. S., for the week ending Sept. 10:

	Tons. Week.	Year.
To United States	276	15,559
" West Indies	—	1,107
" South America	—	1,002
" Canada	5,156	100,839
" Other Provinces	3,830	36,103
	9,262	154,610

Shipments from the Block House, Cow Bay, C. B., to the following destinations, from Aug. 24 to Aug. 31, 1875:

	Week.	Year.
Provinces	—	4,934
West Indies	—	806
United States	1,065	6,131
	1,065	11,871

COAL TRADE REVIEW.

Duties.

Anthracite free, *Bituminous*, per ton of 28 bushels, 80 lb. to the bushel, 75c., gold.

All *slack*, or *culm*, such as will pass through a half-inch screen, per ton of 28 bushels, 80 lb. per bushel, 40c. gold.

Not otherwise provided for, per ton, 40c. gold.

NEW YORK, Friday Evening, Sept. 17, 1875.

Anthracite.

The demand for anthracite coal is constantly falling off, and stocks are largely on the increase; the increase at Port Richmond alone, last week, was 45,000 tons, making the total stock there 135,000 tons. Lehigh stove and egg sizes are in very good demand, and some dealers are well supplied with orders for all sizes; others, however, find considerable slackness in other sizes. Prices have been quite irregular, and some "stock coal" offered by the Delaware and Hudson Canal Company at from 50c. to 60c. a ton under circular rates, has created considerable dissatisfaction among the dealers. The company claim that the coal has been in stock for several years, and has greatly deteriorated, while others who claim to have seen some of it say that it is fully equal to any coal they sell. We are authorized to say that these coals have been withdrawn from the market. The Philadelphia and Reading Company are reported to have refused to take certain sizes of coal from members of the Schuylkill "Pool." We are informed, however, that the sizes refused are the larger ones, which can be broken into the smaller and more popular sizes; and as the Reading Company are doing this to a large extent, it is only fair that other members should do the same. Prices for October will be fixed on Monday. It is the general opinion that an advance should not be made, but we shall not attempt to predict what will be done. It is believed that the out-put for next month will be curtailed. Freights from this city to Boston have advanced, while at Philadelphia they remain unchanged, thereby compelling New York shippers to pay greater drawbacks, and making them more desirous to have this question settled upon a basis that will give them the full price for their coal. We find none who express encouraging views of the business likely to be done during the balance of the year.

The production of Anthracite coal for the week ending September 11th was 562,659 tons, and from January 1st, 11,492,573 tons. The production for the corresponding week of 1874 was 476,335 tons, and from January 1st, 1874, 13,160,541 tons. The production for the week ending September 4th, 1875, was 567,908 tons. From the above figures it will be seen that there was a decrease, last week, from the production of the week previous, of 5,249 tons, and an increase of 86,324 tons over the corresponding week of 1874. There has been a decrease since January 1st, as compared with the corresponding period of 1874, of 1,106,530 tons.

Bituminous.

The demand appears to be quiet, yet there is considerable coal moving, the Cumberland out-put last week having increased about 9,000 tons over the previous week. Prices are low and somewhat irregular. Cumberland is quoted at $3 90@$4 at Georgetown, and $4 25 at Baltimore, although sales are frequently made below these figures. Broad Top and Clearfield coals are quiet and irregular in price.

Foreign and Gas Coals.—There are a number of cargoes of foreign coals on the way here, but mostly on orders. Domestic gas coals are being largely delivered on contracts, but new sales are very scarce and unimportant.

Freights.—From this port to Boston, freights have advanced to $1 30@$1 35 per ton. At Philadelphia, vessels are not so abundant as they were, although rates are unchanged. At Georgetown $1 60@$1 65 is being paid to Boston.

Philadelphia Coal Trade.

PHILADELPHIA, Sept 16, 1875.

The difference between the scarcity of orders for Schuylkill and the abundance of orders for Lehigh is getting more marked every day. The advance in Schuylkill coal was a mistake, with the disadvantage the Schuylkill Region is laboring under, of very high tolls. Vessels which were more plenty at the beginning of this week are again scarce, and there is a large accumulation of coal at Port Richmond, and orders there are not very plenty. The pool is blocked with broken and chestnut, and those sizes have been stopped for the present at the mines. Several of the companies' collieries are also said to be idle. In order to give to the dealers another taste of what the President of the Reading Railroad Company calls "fair competition" chestnut is now retailed by the company at one of their storing places at $4 50, which is below the cost of the minimum price of chestnut at Port Carbon, and of the minimum tolls to any point in the city by the Reading. The consequence of this policy is that the dealers will store no coal at the end of the season, fearing the action of the Company in lowering prices. The dealers have no objection to lower prices, but they decidedly object to high prices at the mines, high tolls, and the coal being put in cars by the company for less than the same coal could be bought by them from the company.

Wholesale Prices of Anthracite Coal for Sept. f.o.b. at the Tide Water Shipping Ports per ton of 2240 lb.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
Wyoming Coals.						
*Lackawanna and Scranton at Rondout and Hoboken	5 05	5 15	5 25	5 55	6 00	4 95
‡Pittston at Newburgh	5 05	5 05	5 15	5 30	5 80	4 85
Wilkesbarre at Port Johnston	5 05	5 15	5 25	5 55	6 00	4 95
Plymouth, R. A., *Net*	....	....	5 25	5 55	6 00	4 95
Susque. Coal Co. at Amboy W.A.	5 05	5 15	5 25	5 55	6 00	4 95
Kingston at Hoboken	5 05	5 15	5 25	5 55	6 00	4 95
Lehigh Coals.						
Old Company at Port Johnston	5 55	....	5 50	5 60	6 00	5 10
Old Company's Room Run "	5 55	....	5 50	5 60	6 00	5 10
§Sugar Loaf, Hobok. &Amb."	5 55	....	5 50	5 60	6 00	5 10
Lehigh Coal Exchange "	5 55	....	5 50	5 60	6 00	5 10
Honey Brook Lehigh	5 55	....	5 50	5 60	6 00	5 10
Spring Mt. C. Co. at Hoboken	....	....	....	....	....	....
Beaver Meadow at South Amboy	5 55	....	5 50	5 60	6 00	5 10
†Schuylkill Coals at Port Richmond.						
Schuylkill white ash	4 55	4 65	4 75	5 05	5 50	4 45
Schuylkill red ash	....	....	5 05	5 15	5 55	4 45
Shamokin white and red ash	....	....	....	5 35	5 70	4 50
Lorberry	....	....	5 80	5 80	5 80	4 65
Lykens Valley	....	....	6 40	6 40	6 40	5 50

Per ton.

Freight from Hoboken and Weehawken to New York.... 40c.
" " Elizabethport & Port Johnston to N. York. 45c.
" " South Amboy to New York.... 50c.

*Freight on Lackawanna coal from Rondout to New York, by boats or barges of the D. and H. Canal Co. 50c. per ton. The expense of towing vessels from New York harbor to Rondout and back will be borne by this Company.

†Freight from Port Richmond to New York (free of discharging) 85c. per ton.

‡ Prices to the Trade.

§ By Canal at New York, Jersey City and Brooklyn, 30c additional alongside.